WATER & SEWAGE WORKS

WATER SUPPLY — SEWAGE DISPOSAL

INDUSTRIAL WASTE TREATMENT

SIDNEY'S WARRAGAMBA PROSPECT PIPELINE
Typical Chasm Crossing—On Right is Tunnel for New 106" Line

Whether your daily water consumption demands be 3,000,000 gallons or hundreds of times that figure, Lock Joint Pipe Company is prepared to provide a supply line for your requirements.

In the last few years the Company has supplied not only hundreds of miles of large diameter pipe but also more than a million feet of 16" to 24" pipe for municipalities and industry. This has been made possible through the establishment of three permanent manufacturing plants. Lock Joint Concrete Pressure Pipe from 16" to 42" in diameter, produced at these plants, can be shipped economically to all parts of the country —for both major installations and minor extensions.

Our representative will be glad to discuss with you any water supply or transmission project which calls for pressure pipe 16" in diameter or larger. You will find that Lock Joint Concrete Pressure Pipe's superior characteristics of long life, continuous high flow and negligible upkeep will recommend it above all others for any permanent water supply installation.

SCOPE OF SERVICES—Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

LOCK JOINT PIPE COMPANY

Est. 1905

P.O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich.

BRANCH OFFICES: Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn.

WATER AND SEWAGE WORKS, Reg. U. S. Patent Off. March, 1960. Volume 97. Number 3. Published monthly by Gillette Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Per copy, 25c; Subscription rate: United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as second class matter March 4, 1948, at the post office at Mount Morris, Illinois, under Act of March 3, 1879.
Executive and business offices, 22 W. Maple St., Chicago 10, Illinois. Editorial office, 155 E. 44th St., New York 17, N. Y.

WATER BY THE PAIL IS SELDOM WASTED!

NEITHER IS WATER IN A

FULLY METERED SYSTEM

It's hard work pumping and toting water by hand. That's why in rural areas water is seldom wasted. Country folk can get along very nicely on 20 gallons a day per person. But make water available at the turn of a tap and people will use all they like—much more than necessary in fact, *unless it is metered.*

Wasted water is an expensive luxury. In areas of scarce supply it can endanger the health and welfare of entire communities. It burdens pumping and treatment plants with an unnecessary load. And extravagant water usage can double or even treble the cost of sewage treatment.

If your system is not 100 per cent metered you must realize that a great deal of water is being wasted. Now is the time to propose metering all the services in your community. We've prepared a complete portfolio of facts that conclusively shows the savings in universal metering. It's yours for the asking, write today.

Pittsburgh Equitable Meter Division
ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pa.

Atlanta Boston Chicago Columbus Houston Kansas City
Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

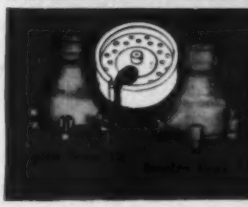
It contains:

(1) Reprints of prize winning essays on the advantages of 100 per cent metering.

(2) Publicity stories on water metering advantages for your release to local newspapers.

(3) Cards showing how water is wasted through leaks—cuts available.

(4) Case histories of actual before and after metering experiences.



PITTSBURGH EQUITABLE
Water Meters

DON'T get caught with your stocks down. Always keep a good supply of Sanitation HTH on hand.

Emergencies are inevitable. In times of floods, broken mains, power failures, chlorinator breakdowns and other unforeseen developments, nothing is as reassuring as plenty of HTH — *in your stock room.* HTH is also handy for those everyday jobs — regular chlorination, sterilizing reservoirs, new water mains, water tanks, or filters.

Sanitation HTH is easy to use and store. It is dry, free-flowing and *always* provides a minimum of 70% available chlorine. Play safe — replenish your stocks of HTH today. For the many uses of HTH write today for your copy of "Hypo-Chlorination of Water." Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Sanitation HTH is available in cases of nine handy 5-lb. cans and in 100-lb. drums.

Mathieson
CHEMICALS

8050

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

WATER & SEWAGE WORKS

WATER SUPPLY—SEWAGE DISPOSAL—INDUSTRIAL WASTE TREATMENT

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

COMING!

Fundamentals of Corrosion— and Its Mitigation

The first part of this important topic was presented in our February issue. The second part "Methods of Mitigating Corrosion" will be published in our April issue, instead of this issue as originally planned. This valuable contribution is the production of the Committee on Corrosion of the New England Water Works Ass'n., and represents the most up-to-date and easily followed explanation of the underlying causes of corrosion and the most effective methods of checking this costly "disease." The Committee—
E. W. MOORE, W. H. SEARS and L. RUBIN.

Sewage Treatment Equipment

Is the subject of a series of articles on the design, installation, operation and maintenance of mechanical equipment in sewage treatment plants. Each article is to deal with some unit operation of modern sewage plants, and will present information of value to designers, operators, and also manufacturers of such equipment. The author is—
FRANK L. FLOOD, Partner, Metcalf & Eddy Engrs., Boston.

Service Line and Extension Trencher

Interesting and timely is the description of a Jeep-mounted trencher, which has proved so handy for making water service line installations and small main extensions, with material savings in labor costs and time. Some cost comparisons indicate where and how this useful piece of equipment can most effectively be employed. The author is—
H. E. LORDLEY, Asst. Director, Dept. of Utilities, Richmond, Va.

Treating Wool-Scouring Wastes

Is the story of the treatment of the wool-scouring wastes and other wastes from a modern carpet mill in Virginia. This article, long delayed unfortunately, describes the treatment plant, method of treatment and results secured. The plant is that recently constructed by the James Lees & Sons Co. at Glasgow, Va. The author is—
STUART E. COBURN, Chem. Eng'r. Metcalf & Eddy Engrs., Boston, Mass.

Water Main Sterilization

Is a subject about which much has been written. This article comprises a condensed statement of recommendations of the A.W.W.A. in water main sterilization procedure and a description of methods, procedure and equipment for doing the job in the latest approved manner by a contributor who has had considerable first hand experience in main sterilization—
HENRY F. MUNROE, Engineer, Proportioneers Inc., Providence, R.I.

Some New Concepts in Sewage Treatment

In this issue is the first of a series of articles reporting on a basic study of the biochemical and physical mechanisms of sewage treatment and of the criteria by which the performance of these mechanisms may be measured and evaluated. These articles introduce a new and simplified approach to the evaluation of plant unit and process efficiency. These articles are the contribution of—
WESLEY ECKENFELDER, JR., and JOHN W. HOOD, Chemist and Sup't., Sewage Treatment Wks., Ridgewood, N.J.

A "Sewabazooka"

If you are curious, watch for the illustrated description of the "Sewabazooka" by—
J. R. JACOBS, Supt., Water and Sewage Works, Moultrie, Ga.

Sewer Maintenance and Operation

Is a running series of articles describing sewer maintenance and operating practices, by—
REUBEN F. BROWN, Supt., Sewer Maint. & Operation, Los Angeles.

Associate Editor
GEORGE E. SYMONS, Ph.D.

Editorial Associates	Adv. Editor
J. R. BAYLIS	H. J. CONWAY
A. M. RAWN	Make-Up Editor
H. A. FABER	L. D. SANDERS

VOL. 97, NO. 3 — MARCH, 1950

CONTENTS

Improving the Water Supply of Sydney, Australia 95
By H. Bowden Fletcher, Panchbowl, New So. Wales

Headaches, Hunches and Hard Work 101
By McKean Maffitt, Wilmington, N.C.

A New Test for Total Hardness of Water 103
By F. R. McCrumb, Baltimore, Md.

A Creeping Drought Under Way 104
By Halbert P. Gillette, San Marino, California

New York's Delaware Water Supply Being Pushed Ahead . 106

Water Treating Experiences (II) 109
By A. H. Ulrich, Austin, Texas

Operation of Small Water Plants 111
By A. E. Clark, Nashville, Tennessee

Industrial Water Supply 113
By George W. Reid, Atlanta, Ga.

A.S.C.E. Sanitary Engineering Division 115

Industry and Pollution Abatement 119
By Edward J. Cleary, Cincinnati, Ohio

Nomograph for Determining Proper Dilution In the B.O.D. Test 122
By John R. Wolfe, Ohio State Board of Health

Graphical Determination of B.O.D. Curve Constants 123
By Harold A. Thomas Jr., Harvard University

Determination of Metals in Industrial Wastes 125
Part I—Iron and Copper
By H. Gladys Swope, T. Jaffe and Mary O'Callaghan, Pittsburgh, Pa.

22nd N.Y. State Sewage Works Assn. Meeting 129

Industrial—Municipal Cooperation 135
By W. H. Wisely, Champaign, Ill.

A Critical Evaluation of Routine Sewage Analyses 138
By W. W. Eckenfelder and John H. Hood, Ridgewood, N.J.

Editorial 142

Meetings Scheduled 92A

"Here and There" with Doc Symons 94A

Manufacturers' and Equipment News 100A

Literature and Catalog Reviews 110A

Water & Sewage Works is indexed regularly by Engineering Index, Inc.

Publication Office, 404 N. Wesley Ave., Mt. Morris, Ill.

(Address communications to the Executive Office or the Editorial Office)

EXECUTIVE OFFICE 22 W. Maple St., Chicago 10, Ill. — **EDITORIAL OFFICE** 155 E. 44th St., New York 17, N. Y.

H. P. GILLETTE, Pres.; E. S. GILLETTE, Vice Pres.; L. H. ENSLOW, Vice Pres.

New York Office ..... 155 E. 44th St., H. D. Crippen, Mgr. F. A. Michel, Rep. E. J. Kall, Rep.

Chicago Office ..... 22 W. Maple St., M. B. Nylund, Rep. R. T. Wilson, Rep.

Cleveland Office ..... Leader Bldg., Lee B. McMahon, Mgr.

Los Angeles Office ..... 1709 W. Eighth St., Don Harway, Rep.

WATER AND SEWAGE WORKS is a monthly publication. Single Copies, 25c; Subscription Rates, U. S. and Canada, $2 per year; Foreign, $3

(Member—Audit Bureau of Circulation and Associated Business Papers.)

Badger Meters solve city's water supply and financial problems

This city's demands for water were expanding. Two wells and the pumping facilities appeared inadequate. No overhead reservoir was available. Financing a third well and pumps was impractical. Water wastage (before installing Badger Meters) seemed excessive. The city decided to try metering as a means of reducing waste. Result: after metering, 24-hour flow was reduced over 55%. No new well needed. The water supply problem was solved . . . so was the financing problem! You, too, will find "It pays to BUY BADGER".

You will find a Badger Meter size and type for every waterworks service. Shown here are Model SC-IOT (for warm climates), and Model A-IOT (for cold climates) . . . sizes ⅝" to 1¼" . . . other models in sizes up to 12". Write for complete information and prices.

NEW! Badger Chart No. 695 (Practical plan for a small meter repair shop). WRITE today for this chart — no charge or obligation.

BADGER METER MFG. CO., MILWAUKEE 10, WIS.

BRANCH OFFICES:
NEW YORK CITY • PHILADELPHIA • WORCESTER, MASS. SAVANNAH, GA. • CINCINNATI • CHICAGO • KANSAS CITY, MO. • WACO, TEXAS • SALT LAKE CITY, UTAH PORTLAND, ORE. • SEATTLE, WASH. • LOS ANGELES

BADGER Water METERS

ACCURACY · LOW-COST MAINTENANCE · DURABILITY · SENSITIVENESS

Slide gates of Alcoa Aluminum Alloy operating between grit chambers and aeration tanks and between aeration tanks and clarifiers.

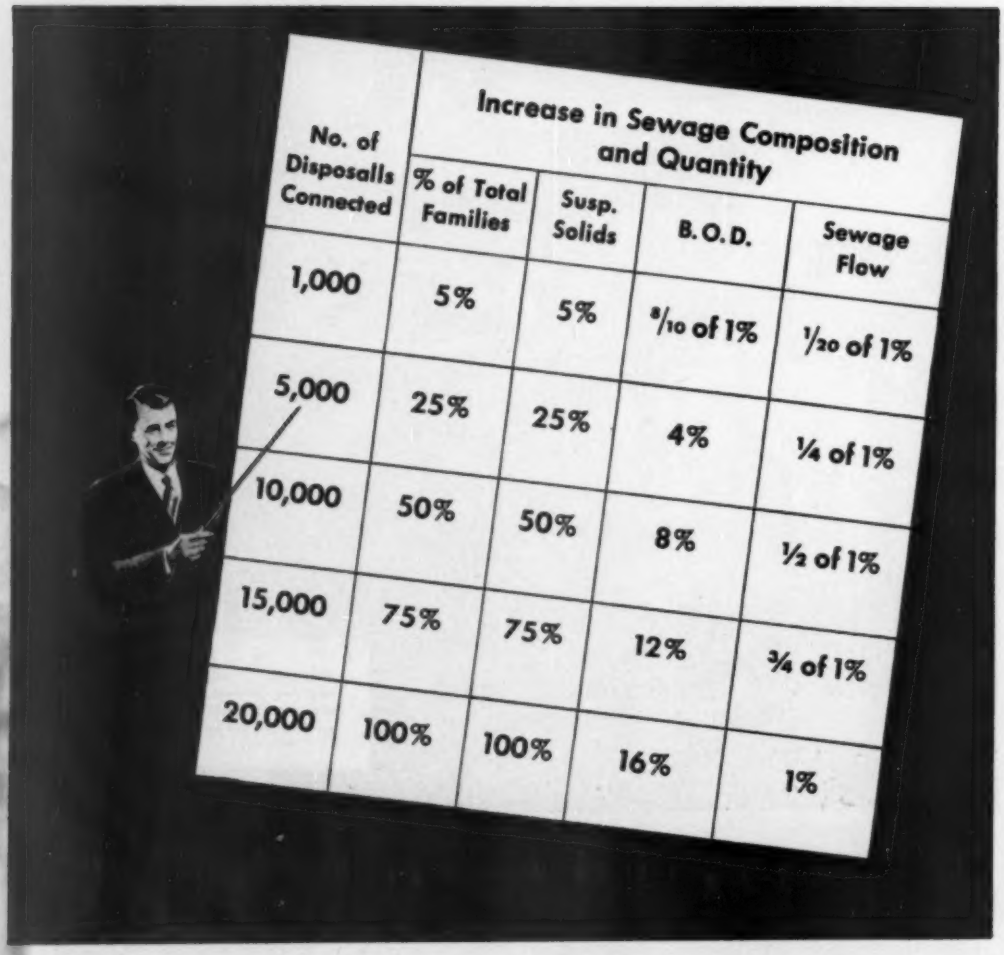
TWELVE-YEAR UPKEEP: ZERO

Had you been in this large southern city in 1938, you might have seen the installation of these slide gates of Alcoa Aluminum as designed by the Atlanta Engineering firm of Wiedeman & Singleton. For an even dozen years, these aluminum gates have laughed at corrosion. They've never needed paint or repairs. Aluminum's lightness is also an advantage in sewage equipment, such as these gates.

Your builder will be glad to fabricate sewage disposal equipment of light, lasting Alcoa Aluminum. To get it, you need only specify Alcoa in your designs. For further information write: ALUMINUM COMPANY OF AMERICA, 2162C Gulf Building, Pittsburgh 19, Penna.

ALCOA ALUMINUM

INGOT • SHEET & PLATE • SHAPES, ROLLED & EXTRUDED • WIRE • ROD • BAR • TUBING • PIPE • SAND, DIE & PERMANENT MOLD CASTINGS • FORGINGS • IMPACT EXTRUSIONS
ELECTRICAL CONDUCTORS • SCREW MACHINE PRODUCTS • FABRICATED PRODUCTS • FASTENERS • FOIL • ALUMINUM PIGMENTS • MAGNESIUM PRODUCTS



No. of Disposalls Connected	Increase in Sewage Composition and Quantity			
	% of Total Families	Susp. Solids	B.O.D.	Sewage Flow
1,000	5%	5%	8/10 of 1%	1/20 of 1%
5,000	25%	25%	4%	1/4 of 1%
10,000	50%	50%	8%	1/2 of 1%
15,000	75%	75%	12%	3/4 of 1%
20,000	100%	100%	16%	1%

We're glad you asked that question

HERE'S THE QUESTION most often asked by sanitation officials when first introduced to the General Electric Disposall*:

"Will this method of shredding food waste and flushing it into the sewer put too heavy a load on the sewer system and sewage treatment plant?"

Our answer to that important question has always been "No!" And it will be "No!" for many years to come.

When food wastes are ground, they are reduced to a far more uniform character than sewage solids themselves. Consequently, they flow even more readily through public sewer systems, they cause no stoppages, and they are readily treated at sewage treatment plants.

By applying the percentage lines shown above to your own city, you can see that in ten years the greatest number of Disposalls that might conceivably be installed would increase sewage flow gallonage less than 1/4 of 1%.

The B.O.D. would be increased about 2.0% and suspended solids about 10%.

It is obvious that these increases could be adequately handled today without expanding the capacity of many plants. And remember, these increases are based on the assumption that one tenth of the homes in your community will have Disposalls within ten years. It takes many

years for an appliance as revolutionary as the Disposall to gain widespread usage. It will be ten years before even one home out of every ten has a Disposall.

The extra loading on the treatment plant caused by the Disposall method of garbage elimination will be but a "drop in the bucket!" for some years to come.

Of course, we can only answer for the General Electric Disposall, the product of years of careful development. And, because the Disposall is the pioneer in the field of scientific garbage elimination—and has proved itself in the laboratory and in countless homes—we can offer you our own strict list of specifications in the development of a dependable food-waste shredder.

We trust that these specifications—shown below—will be of value to you in judging all such appliances and in protecting the health, safety and economy of your community!

GENERAL ELECTRIC'S SPECIFICATIONS FOR ITS FOOD-WASTE SHREDDER— THE DISPOSALL

1. *The Disposall has a flow interlock that permits operation with cold water only.*

This requirement is necessary because experience has shown that only with cold water will greases become congealed within the cylinder. With congealed grease broken up into small particles, mixed with food waste and carried off through the drain, there can be little tendency for greases to adhere to the walls of the pipe.

2. *The discharge from the Disposall remains in a fluid state. The correct relationship between the amount of food waste and tap water is maintained by controlled shredding.*

This equalization of water and food waste is essential to permit the ready flow of effluent through traps, drain, or soil lines in a manner to prevent clogging.

3. *The Disposall shreds food waste to a uniform size, to meet the following requirements: 100% shall pass a ½-inch screen. At least 90% shall pass a ¼-inch screen. Not more than 5% shall pass a #40 sieve.*

(Screens should be the United States standard, and weight should be taken on a dry basis.)

In other words, the particles of shredded food waste are of the correct size, to permit effective sewage clarification and sludge digestion at the treatment plant.

4. *The food-waste shredder is self-scouring, with no fouling surfaces.*

This feature prevents objectionable odors; keeps the unit clean as a whistle.

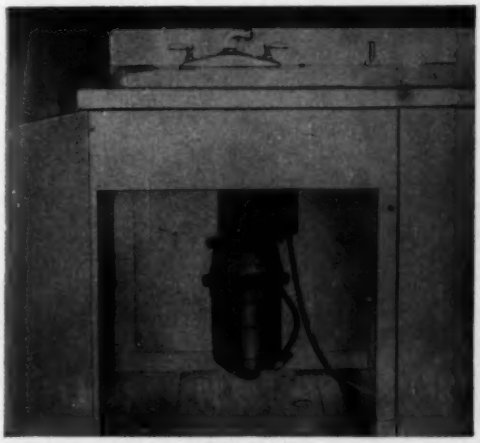
5. *The food-waste shredder provides maximum protection against electrical or mechanical hazards.*

As a safety measure, the shredding compartment is inaccessible during operation.

6. *The food-waste shredder is designed for connection to the plumbing, in accordance with the local plumbing code, and is free from any cross-connection.*

This regulation eliminates any makeshift, homemade hook-ups, and permits the proper operation from sink to sewage-treatment plant.

For further information about the Disposall method, simply write to Department WW-503, General Electric Company, Bridgeport 2, Connecticut.



The General Electric Disposall is easily installed in almost any sink. Here it is shown installed in our electric sink. Food waste is scraped into drain opening, and safety cover is placed in position. The cold-water tap is then turned on, starting the Disposall operation. Food waste is shredded and flushed away automatically.

P. S. Thousands of Disposalls are operating successfully on private septic tank systems.

Disposall

*General Electric's registered trade-mark for its food-waste disposal appliance

CONVERTS FOOD WASTE TO SEWAGE—ELIMINATES "GARBAGE"

GENERAL ELECTRIC

Without beam strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada.

Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES

HOLLINGSWORTH & WHITNEY CO.

Water Treatment Plant, Mobile, Ala.

(Completed in 1949)

FAY, SPOFFORD & THORNDIKE
Engineers
Boston New York

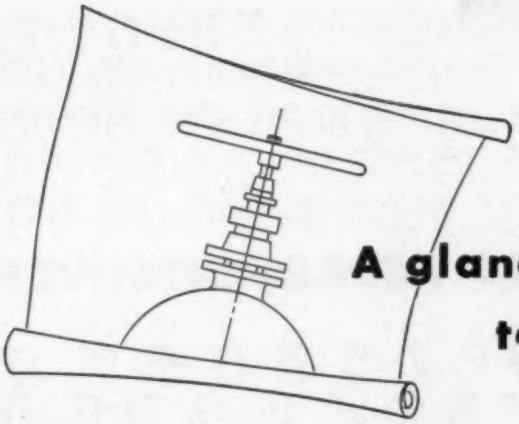
At Hollingsworth & Whitney Co., in Mobile, Ala. this industrial water treatment plant is vital to the production of high-quality paper. Employing the latest in water purification equipment and methods, the treatment plant supplies up to 10 MGD of clear, color-free water . . . an essential raw material in the paper manufacturing processes.

Omega Feeders, installed by Rust Engineering Co. of Pittsburgh, Pa., feed the chemical coagulants required for turbidity elimination and also the lime or soda ash for control of pH. For Bulletins describing Omega Feeders, address Omega Machine Company, (Division of Builders Iron Foundry), Providence 1, R. I.

Omega equipment furnished for the Hollingsworth & Whitney Co. water treatment plant:

- **2 — No. 1 Universal Feeders for soda ash**
- **1 — No. 1 Universal Feeder for alum**
- **4 — No. 2 Universal Feeders for hydrated lime**
- **1 — Rotodip Solution Feeder for metering and feeding liquid alum**
- **2 — No. 1 Dust Collectors**

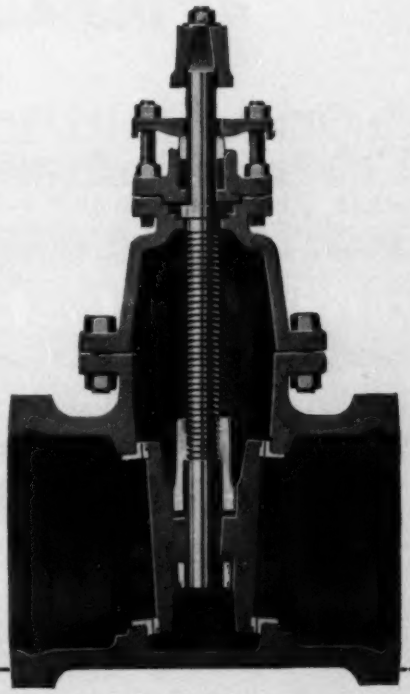
THE LAST WORD IN FEEDERS
OMEGA



A glance at the blueprint tells the story

ONE LOOK at the design of R. D. Wood Gate Valves and you know they will deliver superior service—they are so simple, rugged and foolproof. An important feature is that there are only three working parts—the spreader and two discs. No small wedges or delicate devices to fail in an emergency. No pockets to fill up with sediment or scale. The valves are fully bronze mounted, all surfaces making a tight seal. They close completely and open fully. In closing, the gates descend opposite the seats before the spreading action is applied. In opening, they move free of the seats before rising into the bonnet and permit unobstructed flow.

Made of thoroughly seasoned castings, rigidly inspected, and tested to 300 pounds hydrostatic pressure, R. D. Wood Gate Valves conform to A.W.W.A. specifications. They are a safety-plus factor for every modern community. Write for complete information today.



R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

FREE! SEND FOR THIS CAST IRON PIPE CALCULATOR

Determines, at a glance, class, weight and dimensions of bell and spigot pipe.

R. D. Wood Company
Public Ledger Building, Philadelphia 5, Pa.

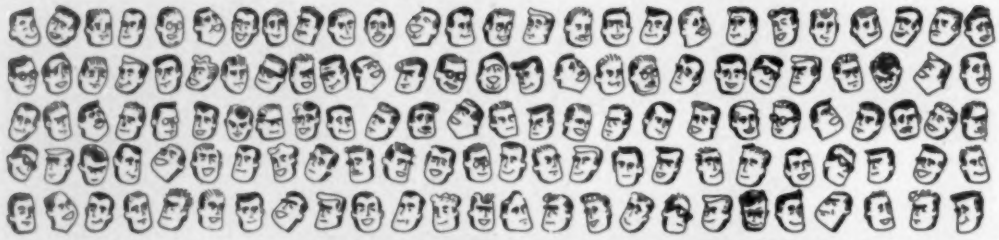
Please send me a Cast Iron Pipe Calculator absolutely free.

Name_____

Name of Firm_____

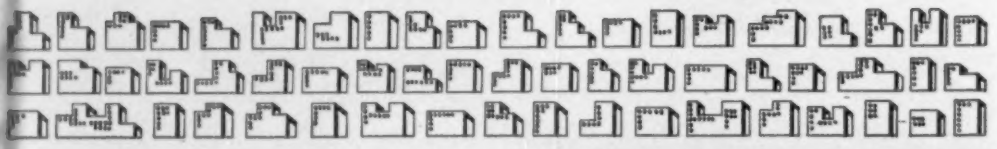
Street_____

City_____ Zone____ State_____



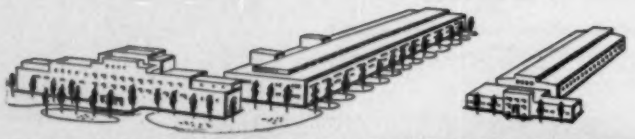
257 FIELD REPRESENTATIVES

48 INSTALLATION INSTRUCTORS



58 SALES OFFICES

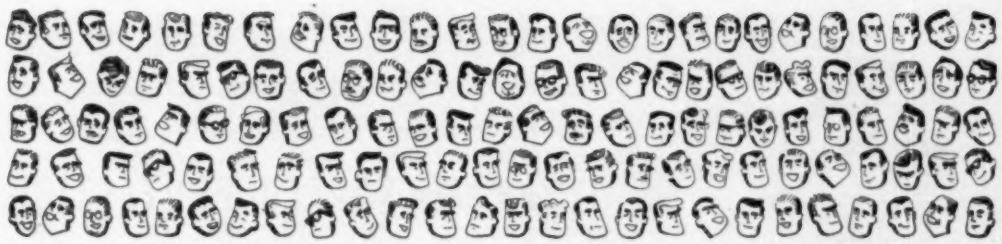
5 MANUFACTURING LOCATIONS



THE LARGEST RESEARCH CENTER OF ITS KIND

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville



At your service—

. . . a complete, nationwide TRANSITE PIPE ORGANIZATION

Here is an organization which, over the past many years, has helped to bring a better, a more efficient and a more economical means of water transportation to many hundreds of American cities and towns.

Its facilities include more than 250 field representatives with headquarters in 58 cities. It also comprises a staff of competent installation instructors who explain recommended installation practices to pipe-laying crews. This Johns-Manville service is an important factor in helping to assure the installation economies as well as the long-term *overall* economies that go with Transite Pressure Pipe.

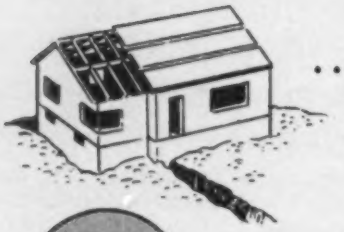
Behind this field organization are the modern production methods which assure the high quality of the finished product. These begin with careful selection of raw materials and are continued through the special processing operations to the final tests which each individual length of pipe must undergo before shipment is made. Five conveniently located plants now serve Transite Pipe users from coast to coast.

And back of all this is engineering—and research. For without them, the plus values that have been built into Transite Pipe would not have been possible. Today, in the new J-M Research Center, the engineer and the technician continue to find new answers to old problems. Their work is an indispensable part of the complete Transite Pipe service which Johns-Manville offers the water works industry. For further information, write Johns-Manville, Box 290, New York 16, N. Y.

*TRANSITE is a Johns-Manville registered trade mark

TRANSITE ASBESTOS-CEMENT PRESSURE PIPE

FOR BETTER WATER SERVICE



. . . as the service lines are extended to new Community Developments . . .

Get the SAFETY PROTECTION OF

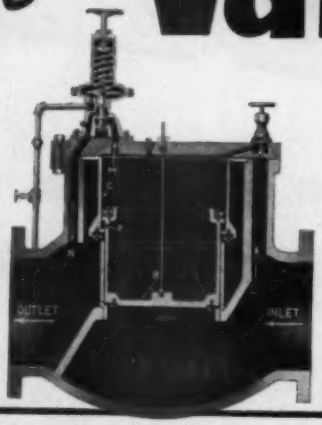
Golden-Anderson

WATER PRESSURE REDUCING Valves

Whenever conditions require maintaining a uniform downstream pressure against a higher inlet head . . . and for high and low water service districts . . . Golden-Anderson Water Pressure Reducing Valves are your answer to efficient, dependable service. In the fully closed position the valve eliminates any building up of excess pressure on the downstream side.

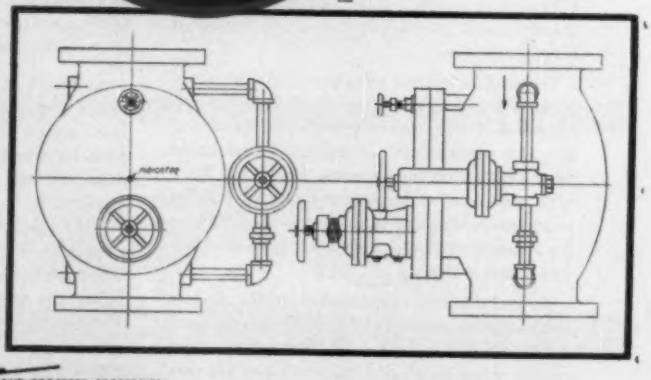
Constructed of special heavy cast iron, semi-steel or cast steel with trim of bronze, Gavalloy or stainless steel —these valves have inherent air and water cushioning to prevent shock or jar.

Auxiliary equipment includes a solenoid pilot control and a manual stop control to limit valve piston travel. All valves are lid-tapped for an atmospheric vent for moving the piston to the full open position. Write for additional technical information.



G-A Water Pressure Reducing Valve, Base Pilot Pattern with flanged ends. In sizes 2" and smaller, this valve generally is furnished with screwed ends.

Schematic drawing of G-A Water Reducing Valve arranged with a by-passing reducing valve to service minimum demands, and a reserve main reducing valve for maximum demands.



Our Engineers

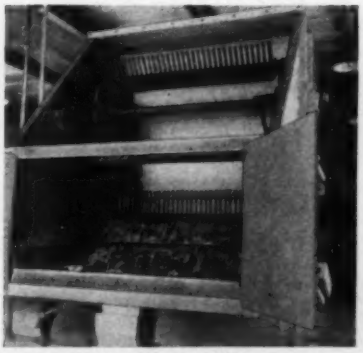
can solve your flow control problems, either with one of the 1500 standard types and sizes of Golden-Anderson Valves, or with a special valve designed for your particular application.

LIFE AND PROPERTY PROTECTION VALVES

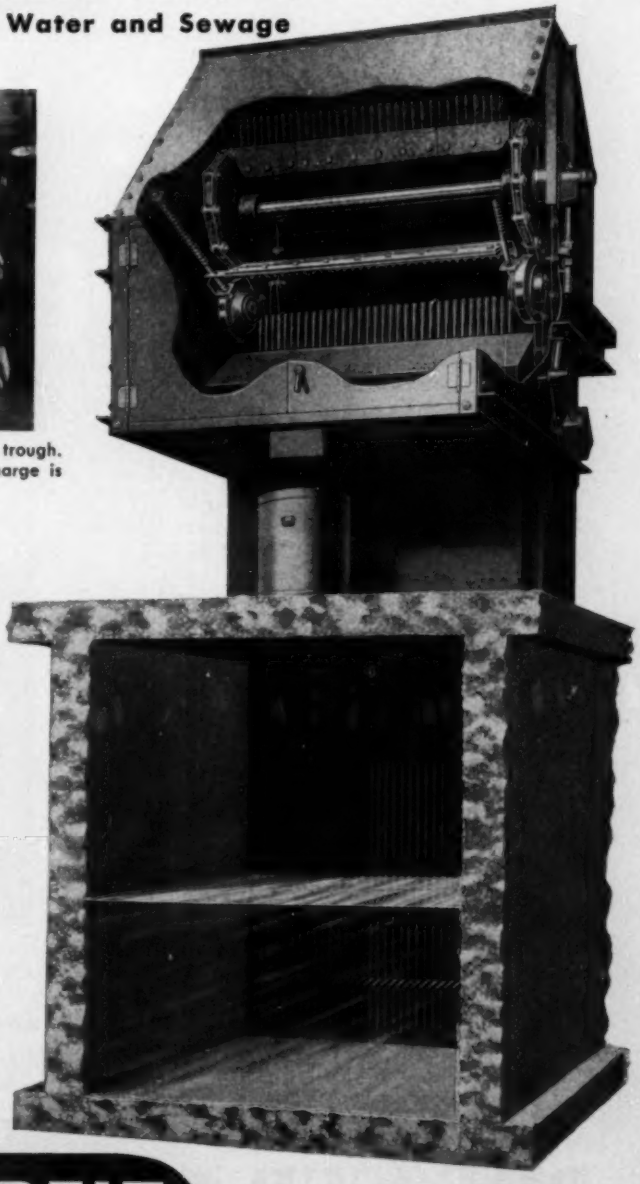
GOLDEN-ANDERSON *Valve* SPECIALTY CO.

KEENAN BUILDING, PITTSBURGH 22, PA.

The New "THRU-CLEAN" BAR SCREEN Efficiently Removes Trash and Large Solids from Water and Sewage



Refuse being discharged on the screenings trough. The clean rakes at top show that discharge is very thorough.



Investigate the new Link-Belt Mechanically Cleaned Bar Screen, and observe how the rakes clean thru the bars from the back.

This screen has many distinctive features. Bottom and top support of screen bars assures alignment. Vertical path cuts down the power required to operate and results in minimum chain wear. Chain take-up is on the head shaft where it is readily accessible for maintaining proper chain tension. The screen cannot be jammed by large objects settling in front of the screen bars since the rake will enter under and lift them.

The screen is of the usual rugged Link-Belt design and is accurately constructed to give long life under the most severe operating conditions. For detailed information, get in touch with our nearest office.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

11,750

A Dresser-coupled steel line delivers water cheaper...

The cheapest way to deliver water to the place where it turns into revenue is with a Dresser-coupled steel line—the line that

- **Cuts installation costs**
- **Cuts leakage losses**
- **Cuts maintenance costs**

Strong, shatterproof, yet lighter in weight, steel pipe swings into place easily. Each section goes as far as several sections of more cumbersome alternate pipe. You have fewer joints, and those more easily and quickly made with Dresser Couplings. Your line is in service sooner . . . you save costly man-hours.

The flexibility of Dresser Couplings cushions every joint and harmlessly absorbs vibration and other stresses that cause rigid lines to leak. You get a permanently tight line that delivers all the water you put into it.

You save on maintenance because the flexible-tight Dresser line "lives in the ground" comfortably and because modern glass-smooth linings assure high-sustained carrying capacity, life-long service.

See your Dresser Sales Engineer, or write today for literature.

In Springfield, Mass., as many as 40 long lengths of pipe were laid and joined in an eight-hour day, using a two-man joining crew.

BE SURE **you get the best line at the best price. Put steel pipe and Dresser Couplings in your specifications.**

DRESSER "FLEXIBLE-TIGHT" **COUPLINGS**

Dresser Manufacturing Division, 59 Fisher Avenue, Bradford, Pa. (One of the Dresser Industries). In Texas: 1121 Rothwell Street, Houston. In Canada: 629 Adelaide St., West, Toronto, Ontario. Sales Offices: New York, Chicago, Houston, Philadelphia, San Francisco.

Chemicals you live by

At one point in your expansion
WE CAN HELP—EXPERTLY

When the pressure is on you for action, and you can use some straight information about chemicals for water improvement, please think of DIAMOND ALKALI.

There is just one point in *your* job where *we* feel thoroughly competent! Where you use chemicals.

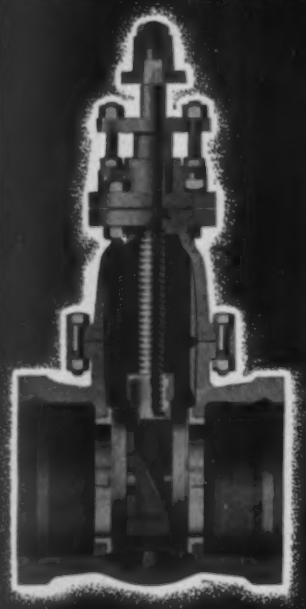
Even if you are not pressed for plans but would like to be forehanded about what's what in purification chemicals, get in touch with the nearest DIAMOND sales office. DIAMOND has four chlorine producing plants, located conveniently for serving the whole nation; a centrally located plant for Soda Ash and Alkali Specialties for water softening and equipment protection, and six plants producing DIAMOND Standard Silicates for settling impurities and clarifying water. One of the sales offices is surely near you: Boston, New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, and Houston. And there are representatives in other principal cities.

DIAMOND CHEMICALS FOR WATER TREATMENT

DIAMOND ALKALI COMPANY...CLEVELAND 14, OHIO

DIAMOND ALKALI CHEMICALS

How Darling features prevent trouble and expense



"This advertisement is one of a series showing how the unique Darling Fully Revolving Double Disc Parallel Seat Gate Valves answer the following critical operating problems:

- Positive, easy closing—regardless.
- Automatic adjustment for valve body distortion.
- Elimination of disc-to-seat friction and galling.
- Uniform wear distribution.
- Extreme simplicity.
- Greater service life.
- Simplified maintenance.

CORROSION RESISTANT VALVES

In addition to conventional iron, bronze and steel constructions, Darling specializes in valves for any corrosive fluid: iron body valves with special alloy trim; iron body, rubber lined, with special alloy trim; all bronze; and all special alloy. Darling's 50 years of experience in meeting unusual requirements is always at your service.

GREATER SERVICE LIFE

EXPERIENCED valve users know that the value of a valve is not determined by its price tag but by its service life, reliability, and the amount of maintenance and down-time necessary to keep it in operation. To assure greater service, the following advantages are combined in Darling's unique Fully Revolving Double Disc Parallel Seat Gate Valves:

1. **Discs do not wear unevenly.** Free to revolve completely, the discs seat in a different position at each closing, thereby multiplying the effective life of both discs and body seats.
2. **Face-to-face contact seating.** In closing, the discs are directly opposite the seat faces before wedging action takes place. In opening, wedging pressure is fully released before *either* gate starts to rise.
3. **Automatic adjustment for body distortion.** Diagonal face of upper wedge is curved and lower wedge face is straight; both faces are transversely beveled, to equalize wedging pressure against discs and permit tight 360° seating despite any misalignment of seats.
4. **Destructive strong-arm methods unnecessary.** Above features entirely eliminate need to "jam" valves shut or "break" them open.
5. **Advanced metallurgy.** Unusually rigid control and advanced methods provide castings that are superior to ordinary castings in strength, density, pressure-resisting characteristics, and in resistance to abrasion and corrosion.

To obtain greater valve life and trouble-free performance, be sure to specify Darling Fully Revolving Double Disc Parallel Seat Gate Valves.

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 11, PA.

Outline your service requirements and get complete *information on Darling Valves of the proper type. Or, send for the complete 300-page Darling Catalog No. 17M. It describes Darling Valves of* all *types for* every *normal or unusual service, and for pressures up to 1500 pounds. It's full of helpful information... Yours for the asking.*

THE VALVE MARK OF QUALITY . . . WATCH FOR IT

better water service

Above: 100,000-gal. Horton ellipsoidal-bottom tank at Jamestown, North Carolina. All municipal installations like this are built in accordance with American Water Works Association specifications.

for any Community... LARGE or Small

There's only one essential difference between Horton elevated water tanks in small towns and their big-city neighbors—the tanks in the big cities usually have a greater storage capacity. Three basic advantages, common to both large and small Horton elevated tanks, are available to the largest metropolis or the smallest village alike. These advantages are maintenance of a more uniform water pressure throughout the distribution system, a reduction in pumping costs and a gravity supply to meet peak loads.

The Horton elevated tank shown at the left is an example of the way in which these attractive structures are used by smaller communities. Installed at Jamestown, North Carolina, this 100,000 gallon tank provides the principal water reserve for this town of 1,000 people. The only other storage used is a 15,000-gallon reservoir. Jamestown is thus assured of the same desirable advantages of uniform gravity pressure and reserve capacity that are provided to bigger communities by larger elevated tanks.

Horton ellipsoidal-bottom tanks like the one shown at the left are built in standard capacities from 15,000 to 500,000 gallons. Larger communities frequently use Horton radial-cone bottom elevated tanks which are built in standard capacities from 500,000 to 3,000,000 gallons. Why not discuss your elevated water storage problem with us? There's no obligation. Write our nearest office for information or quotations.

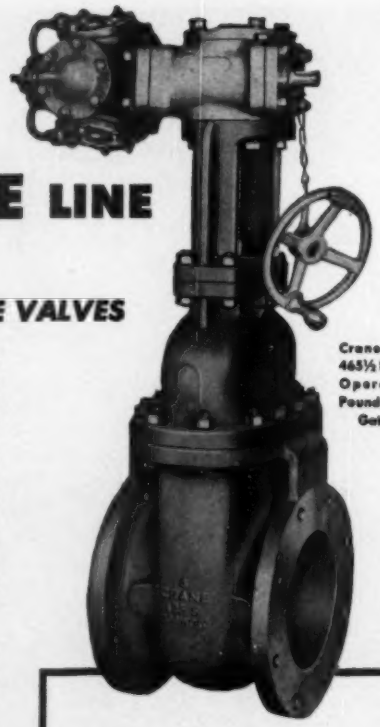
CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2181 Healey Building	Detroit 26	1551 Lafayette Building	Philadelphia 3	1644—1700 Walnut Street Building
Birmingham 1	1586 North Fiftieth Street	Houston 2	2115 National Standard Building	Salt Lake City 4	550 West 17th South Street
Boston 10	1048—201 Devonshire Street	Havana	402 Abreu Building	San Francisco	1203—22 Battery Street Building
Chicago 4	2190 McCormick Building	Los Angeles 17	1555 General Petroleum Building	Seattle 1	1350 Henry Building
Cleveland 15	2262 Guildhall Building	New York 6	3390—165 Broadway Building	Tulsa 3	1646 Hunt Building

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

ANSWER TO A SPECIFIC NEED NOW IN THE CRANE LINE

NEW, LOW-COST FLUID-MOTOR OPERATED GATE VALVES



Crane 8-Inch No. 465½ Fluid-Motor Operated 125-Pound Iron Body Gate Valve.

These valves fill the need for a power-actuated pipe line control at lower than usual cost. By utilizing a simplified fluid motor, they permit wider application of mechanically-operated valves to increase plant efficiency.

Low in first cost . . . low in operating cost . . . Crane Fluid-Motor Operated Valves save labor, help prevent accidents and offer definite advantages when installed on hard-to-reach valves or on valves used in timed operating cycles.

OPERATE AT LOW COST—Crane Fluid-Motor Operated Gates utilize pressure sources readily available in most plants—compressed air, water, or oil . . . at pressures ranging from 40 to 300 psi.

HIGH STARTING TORQUE—Motor is reversing type and is designed to exert greater torque when unseating the valve than when seating it. Added power to open valve against sticking is assured.

NO WASTE OF POWER . . . NO LOSS OF FLUID—Pressure-tight motor stalls when disc is in fully open or closed position. Motor can remain stalled indefinitely . . . under full pressure . . . with no leakage of operating fluid. No power is wasted in maintaining fluid at proper operating pressure.

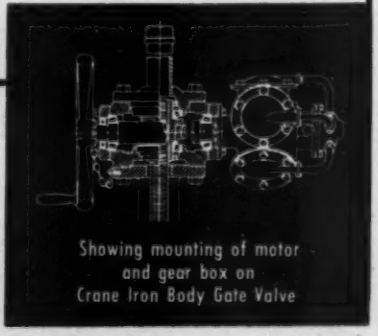
Crane Fluid-Motor Operated Valves are now available in the following pressure classes, types and sizes:

25-pound wedge disc gate	12-in. to 30-in.
125-pound wedge disc gate	5-in. to 20-in.
25-pound double disc gate	10-in. to 30-in.
100-pound W.O.G. double disc gate	6-in. to 24-in.
A.W.W.A. double disc gate	4-in. to 20-in.
Pulp Stock Valves	8-in. to 20-in.

How Crane Fluid-Motor Works

Radial-type motor has five diaphragm sealed chambers. Operating fluid, admitted through a 4-way distributing valve, acts against diaphragms to exert force against pistons. The pistons, in turn, transmit the thrust to an eccentric which causes drive shaft to rotate. Hammerblow device in gearbox allows motor to attain speed before loading and provides impact to overcome friction of valve parts.

Send for this descriptive folder—See how Crane Fluid-Motor Operated Gate Valves can help increase the operating efficiency of *your* plant. Ask your Crane Representative for your copy, or WRITE FOR FOLDER AD-1803. No obligation.



Showing mounting of motor and gear box on Crane Iron Body Gate Valve

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

NUCHAR
INSURES PALATABLE DRINKING WATER

NO PLACE FOR GRASS

THERE'S no place for grassy, fishy or other foul tastes and odors in the modern water distribution system. And the modern way to detect and protect against these offensive tastes and odors is to use the Threshold Odor Test plus Aqua Nuchar Activated Carbon. The Threshold Odor Test supplies the means of measuring odor intensities in water, while Aqua Nuchar Activated Carbon has proved to be the most effective, economical method to remove objectionable tastes and odors from water supplies.

Threshold Odor Test demonstrations have been presented by our Technical Service Department at many schools throughout the country, and also to groups of health department and water personnel. Anyone interested in having such a demonstration presented, should write to our nearest office. Groups of up to 40 individuals can be accommodated at one time.

OTHER PRODUCTS: *Snow Top Precipitated Calcium Carbonate • Nuchar Activated Carbons • Liqro Crude Tall Oil • Indusoil Distilled Tall Oil • Tallene Tall Oil Pitch Tallex Abietic Acid • Sulfate Wood Turpentine • Alpha Pinene • Beta Pinene Polycel Cellulose Fibers • Indulin (lignin)*

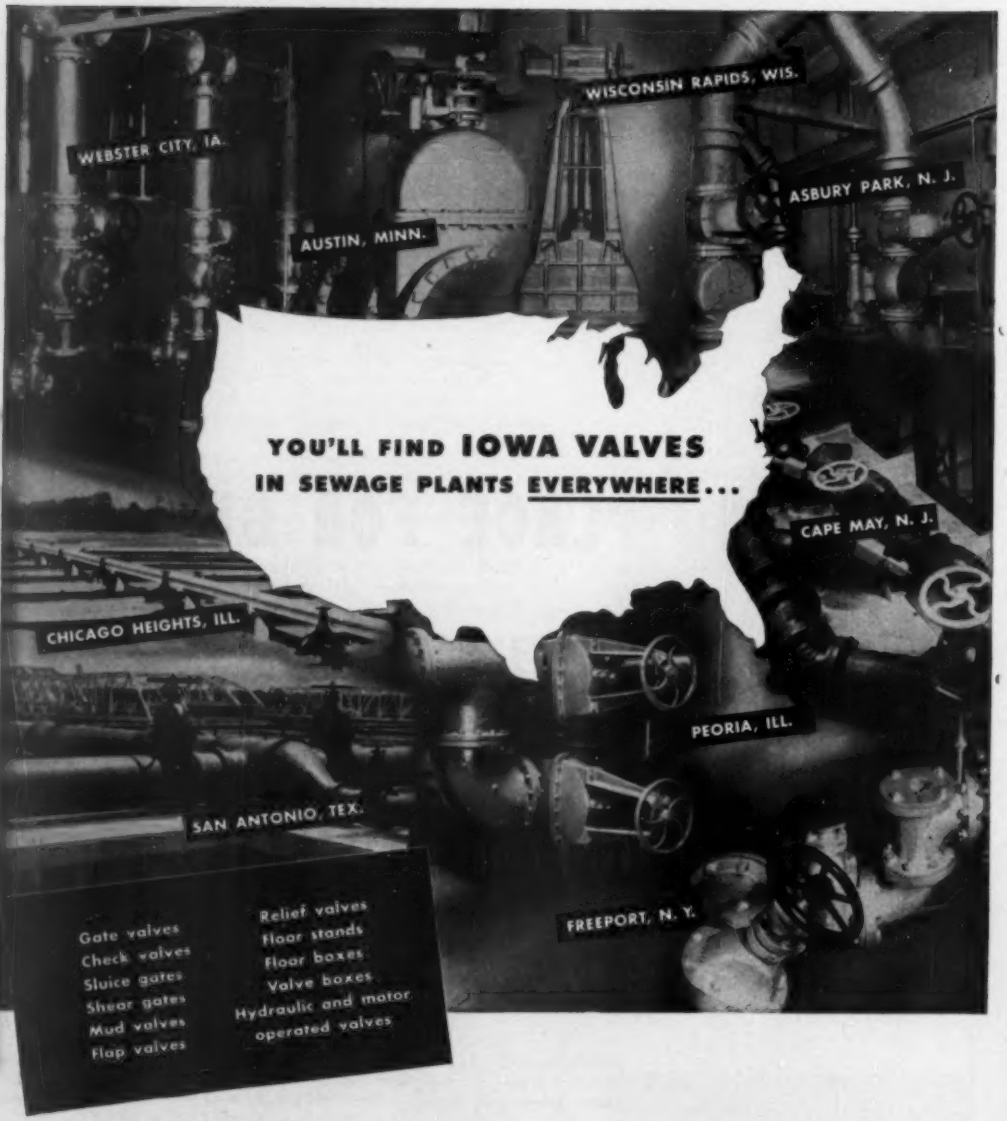
NEW YORK CENTRAL BLDG.
230 PARK AVENUE
NEW YORK 17, N. Y.

PURE OIL BLDG.
35 E. WACKER DRIVE
CHICAGO 1, ILLINOIS

PUBLIC LEDGER BLDG.
INDEPENDENCE SQUARE
PHILADELPHIA 6, PA.

LEADER BLDG.
526 SUPERIOR AVE., N.W.
CLEVELAND 14, OHIO

industrial CHEMICAL SALES
division west virginia pulp and paper company



IOWA manufactures a complete line of valves for sewage treatment plants

***Specify* IOWA VALVES and let us solve your problems on sewage flow control**

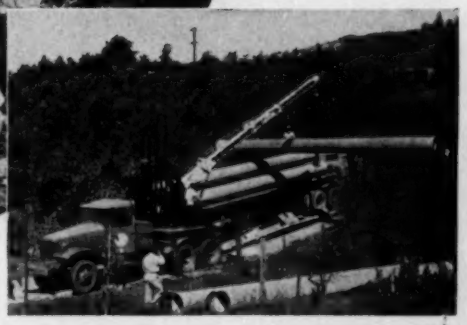
IOWA VALVE COMPANY

201-299 N. Talman Ave., Chicago 80, Ill. • *A Subsidiary of James B. Clow & Sons*

You Can't Beat Hydrocrane's "Fractional-Inch" Control!

SAYS LA MESA IRRIGATION MANAGER

Here the La Mesa Irrigation District's Hydrocrane sets 20-in. cast iron pipe weighing about 3500 lbs. per length. With low telephone and power lines on sections of this job, the Hydrocrane's maneuverability and telescoping boom were big advantages.



"You can't beat the Hydrocrane's 'fractional-inch' control on pipe laying or machinery setting operations," says M. J. Shelton, manager and chief engineer of the La Mesa, Calif., Irrigation District. "This hydraulic rig eases heavy units into place with a smoothness you can't get with other equipment.

"Rugged terrain makes our pipe setting especially tough. On one job we operated on hills several hundred feet long with 44% grades, and through avocado groves where working space was limited. The Hydrocrane was used on all the pipe handling work, including pulling the joints together. Pipe was 18-inch steel-reinforced concrete weighing about 4000 lbs. per 31-ft. section. Even under extremely adverse conditions, the crane set an average of 200 ft. of pipe per day.

"We have the Hydrocrane in almost continuous operation on all types of crane work. Its mobility makes it extremely valuable to us, as we operate in a mountainous country."

Two models — 1/4 yard, 2-ton and 3/8 yard 3-ton. Available with clamshell bucket, magnet, snowbucket, catch basin bucket, 3-tine grapple, forked grab, and crane hook. All operating functions fully hydraulic. Send the coupon for complete details.

BUCYRUS-ERIE HYDROCRANE DIVISION
SOUTH MILWAUKEE, WISCONSIN

Gentlemen: Tell me how the Hydrocrane can speed up my jobs.

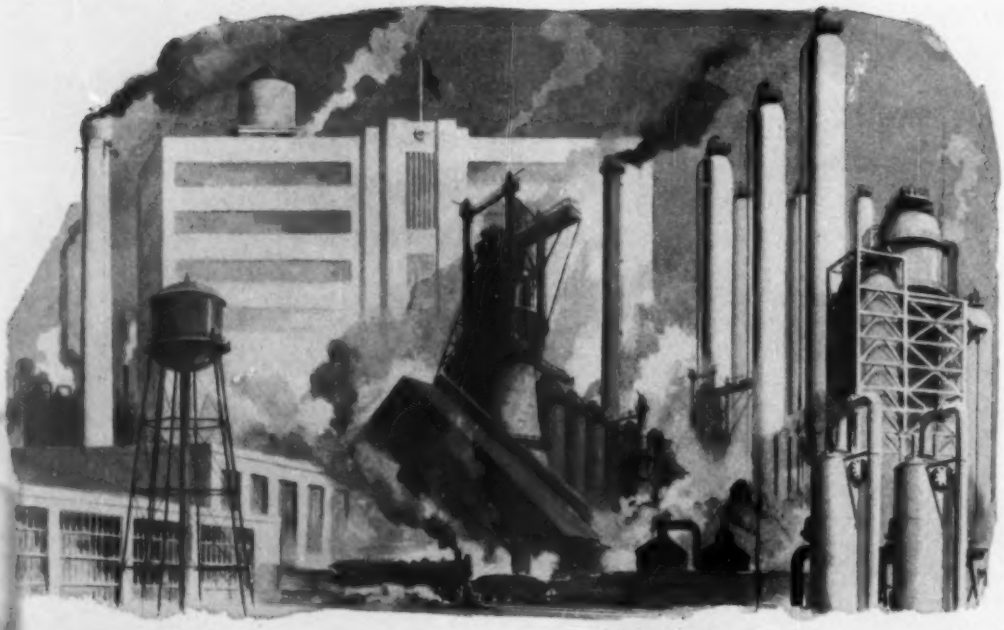
Name.....

Company or Department.....

Address.....

City.....State.....

SOUTH MILWAUKEE BUCYRUS ERIE HYDROCRANE WISCONSIN



INDUSTRY *and the* ROTOVALVE

MARCHING toward new goals—in a mechanized manufacturing world — industrialists, engineers, plant managers and management of all kinds are exploring every means of cutting costs and increasing efficiency. This explains the great demand and use of Rotovalves. Their design permits the conical plug to lift, rotate and seat itself, and assures free flow through a full circular opening in both valve body and plug, thereby cutting losses.

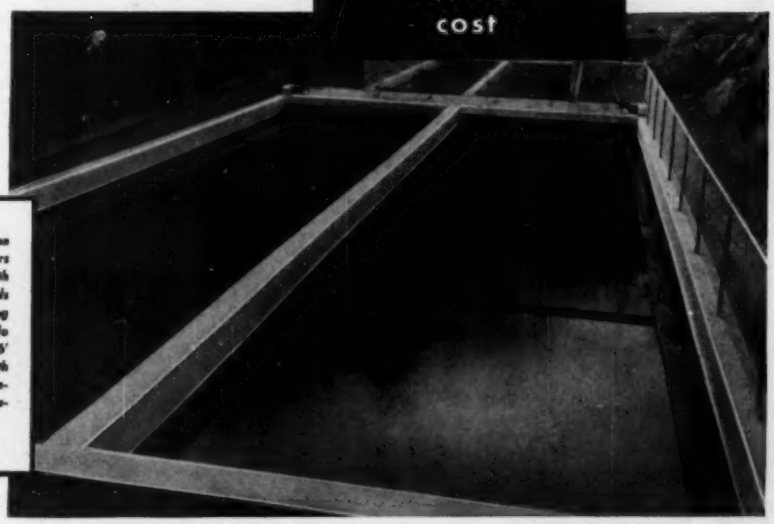
Available with either manual, hydraulic or motor control, and in all sizes to fit any industry! *Shipment from stock.* Send for complete data.

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.

Treat your plant to these advantages...

clearer effluent
•
greater capacity
•
lowest cost



Ashland, Oregon Water Filtration Plant employing 2 Rex Flash Mixers in 6' square x 5' 2" water depth basins; 2 Rex three-stage Floctrols in 2 basins each 12' wide x 58' long x 12' water depth; 2 Rex Verti-Flo settling tanks, each 20' wide x 86' long x 14' 9" average water depth and each equipped with Rex Conveyor Sludge Collectors. Plant Capacity—6 MGD.

Where you want *real* results from your water treatment plants . . . clearer effluent . . . maximum capacity at minimum cost in new or existing installations, check Rex Clarification Equipment.

REX FLASH MIXERS effect almost instantaneous dispersion of chemical throughout the water. Installed in small tanks immediately preceding flocculation tanks, they provide an exclusive double mixing action. Slow rotation is combined with fast top-to-bottom turnover for most thorough mixing. One-minute detention is usually sufficient.

REX FLOCTROLS are low in initial cost and cut chemical requirements to the minimum. They combine properly proportioned, scientifically designed paddles . . . rotating baffles . . . fixed partition walls with center ports . . . so arranged that thorough mixing is assured and short circuiting through the chamber eliminated. The resultant fast tapered mixing by zones assures large, readily settleable floc.

REX VERTI-FLO CLARIFIERS deliver a highly clarified effluent with an extremely short detention time. They consist of a series of adjustable weirs and baffles which divide a rectangular settling tank into a series of cells. Close distribution of flow among the cells is accomplished by adjusting the weirs. Large weir length and low vertical velocities assure a clearer effluent, far greater capacity . . . minimum cost.

For all the facts on these efficient units, mail the coupon.

CHAIN BELT REX COMPANY — SANITATION EQUIPMENT

CHAIN BELT COMPANY
1610 W. Bruce Street
Milwaukee 4, Wis.

Please send me Bulletins Nos. 47-9 and 48-39

NAME.....

COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

Mohawk, New York 1842
Newark, New Jersey 1867
Hudson, New York 1868
Nashua, New Hampshire 1869
Chelsea, Massachusetts 1870
Savannah, Georgia 1870
San Francisco, California 1871
Milwaukee, Wisconsin 1873
New London, Connecticut 1873
Portland, Maine 1874
Kokomo, Indiana 1874
North Adams, Massachusetts 1875
Grand Rapids, Michigan 1878
Indianapolis, Indiana 1879
Lockport, New York 1879
Utica, New York 1880
Bay City, Michigan 1881
North Manchester, Indiana 1883
Racine, Wisconsin 1883
Appleton, Wisconsin 1884
Oshkosh, Wisconsin 1885
Los Angeles, California 1886
Minneapolis, Minnesota 1886
St. Paul, Minnesota 1888
Portland, Oregon 1889
Galveston, Texas 1889
Waukesha, Wisconsin 1889
Louisville, Kentucky 1890
South Bend, Indiana 1891
Wausau, Wisconsin 1893
Superior, Wisconsin 1895
Salt Lake City, Utah 1895
Atlanta, Georgia 1895
Augusta, Georgia 1895
Springfield, Massachusetts 1896
Bangor, Maine 1896

Here's an underground operation in 36 cities that proves the durability of *CONCRETE PIPE*

For more than 50 years concrete pipe sewers have served continuously and faithfully in the thirty-six American cities listed above.

In fact this successful underground operation has been going on for 60, 70, 80, 100 or more years, in more than three fourths of these cities. Such long service records offer ample proof of the durability of concrete pipe for sewers.

Durability and long life are but two of the outstanding qualities of concrete pipe for sewer use. The others are:

- A uniformly dense structure with clean, even joints that can be made watertight—thus assuring minimum infiltration and leakage.
- A smooth interior finish that resists the wearing action of suspended abrasive matter and which provides maximum hydraulic capacity.
- Unusual strength that resists severe impact and sustains heavy overburdens.
- Unusual economy due to its moderate first cost, its long service life and its low maintenance cost. These three factors result in *low-annual-cost* sewer service—and that is the only true measure of economy in pipe line operation.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

STAYS PUT

...because

Aluminum Lasts!

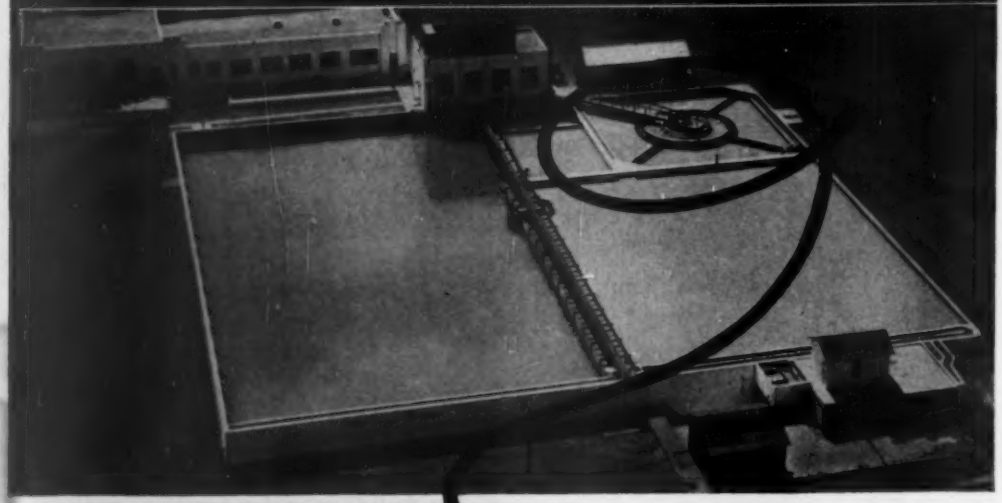
ALCOA
FORGED ALUMINUM MANHOLE STEPS AND LADDER RUNGS

Here's a new kind of metal step that's strong, safe, durable. Because it is made of highly corrosion-resistant Alcoa Aluminum Alloy, this forged step requires virtually no maintenance, lasts years longer. It is safe—non-sparking, and grooved for a firm foothold. Easily installed in any type of masonry, this sturdy aluminum step will take a 1,000-pound load without permanent deformation.

Available in three sizes for easy installation in any type of masonry, outside or inside. Call your nearby Alcoa Sales Office for information and prices. Or write for free folder. ALUMINUM COMPANY OF AMERICA, 1809B Gulf Bldg., Pittsburgh 19, Pa.

SAFE • NON-SPARKING • STRONG • DURABLE • ECONOMICAL

HOW TO TURN AN EXISTING BASIN



ACCELATOR installations: (Above) City of Gainesville, Fla., (Below) City of Cushetton, Okla.

Into a Modern Water Conditioning Plant!

The ACCELATOR®
MAY BE ROUND OR SQUARE

At Muskogee, Oklahoma, a cyclone severely damaged the water treating plant. In rebuilding, they placed a *square* Accelator within the still-standing square settling basin. This saved the extra cost of building an external *round* basin. Today, the compact 70 ft. square ACCELATOR turns out *twice* as much clarified and softened water as the 210 ft. square settling basin did before! ★ Square, or round, the Accelator gives *any* municipality the means of converting turbid or hard water into a sparkling, clear, soft effluent. Over 1100 Accelator installations economically treat more than *One Billion* Gallons of water *every day!* Get all the facts.

SEND FOR..

our colorful new 28-page Bulletin No. 1825. It's packed with vital information about this better, more economical way to condition water.

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894

INFILCO INC.

SALES OFFICES IN TWENTY SIX PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

VERTICAL TURBINE PUMPS

—are built in sizes from 40 to 16,000 gallons per minute. They may be installed in existing wells, saving the expense of a new drilling job. Other uses include fire protection, booster service, cooling tower, river pick up and a wide range of other uses. Send for the Layne Vertical Turbine Pump catalog.

WHAT'S TO BE SAID

ABOUT SATISFIED USERS

The building of dependable water producing equipment involves a lot of extraordinary skill. And when it comes to skill Layne leans mighty heavily on seventy years of world-wide experience. It is from such experience that Layne has been able to find and strengthen weak points, use tougher and longer lasting materials and to constantly increase efficiency. As a result, users almost invariably stick to Layne equipment on each of their additional units.

It is a widely known fact that Layne Well Water Systems, point for point, always measure "head and shoulders" above any other make. This means that there is no advantage whatever in buying the so called "just as good" equipment. Furthermore there is no use telling you that this or that Layne part is super-duper. What you are buying—and have every right to expect, is unquestionably good performance over a long period of years. That, in brief, is exactly what Layne offers without reservations of any nature.

If you now need, or expect to have need for more water at some future date, get in touch with Layne, or send for further information, catalogs, bulletins, etc., Address

LAYNE & BOWLER, INC.
GENERAL OFFICES, MEMPHIS 8, TENN.

LAYNE

BUILDERS OF HIGH EFFICIENCY

WELL WATER SYSTEMS

ASSOCIATED COMPANIES—Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Pacific, Inc., Seattle, Wash. ★ The Layne-Texas Co. Ltd., Houston, Tex. ★ Layne-Western Co., Kansas City, Mo. ★ Layne Minnesota Co., Minneapolis, Minn. ★ International Water Corp., Pittsburgh, Pa. ★ International Water Supply, Ltd., London, Ont. ★ Layne-Hispano Americana, S.A., Mexico, D. F. ★ General Filter Company, Ames, Iowa.

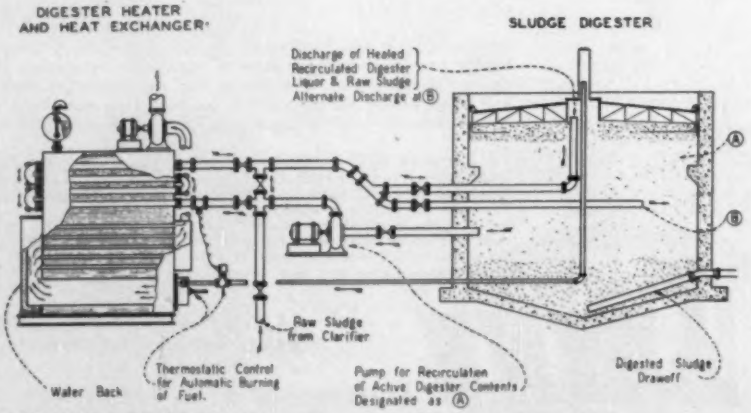
THIS METHOD OF ACCELERATING DIGESTION MAKES SENSE !

Four No. 500 P.F.T. Digester Heaters and Heat Exchangers serve 4 85' and 6 50' P.F.T. Floating Cover Digesters at Dayton, Ohio. L. C. Hoffman, Engineer.

It has been found that action of the methane producing bacteria is less deterred by temperatures above or below the optimum than by fluctuations in temperature. P.F.T. Digester Heater and Heat Exchanger units provide a safe, practical and economical means of maintaining sewage sludge undergoing digestion at an optimum temperature.

Furthermore, there are no coils of piping in the digestion tank to become caked with sludge and therefore insulated against proper heat transfer. Circulation is such that a more uniform temperature is maintained throughout the sludge mass.

P.F.T. Digester Heaters employ methane gas from the digestion tank for fuel. P.F.T. Gas Engine Heat Exchangers employ heat from sludge gas engine jacket cooling water to keep the sludge at optimum temperature. A list of installations to date is available on request to Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.


DIGESTER HEATER AND HEAT EXCHANGER
SLUDGE DIGESTER
Discharge of Heated Recirculated Digester Liquor & Raw Sludge Alternate Discharge at Ⓑ
Ⓐ
Ⓑ
Raw Sludge from Clarifier
Water Back
Thermostatic Control for Automatic Burning of Fuel.
Pump for Recirculaten of Active Digester Contents Designated as Ⓐ
Digested Sludge Drawoff

OTHER P.F.T. EQUIPMENT INCLUDES:
Floating Covers, Gas Safety Equipment, Rotary Distributors, Sprinkling Filter Nozzles, Siphons, Pre-Aerators and Gages.

P.F.T.

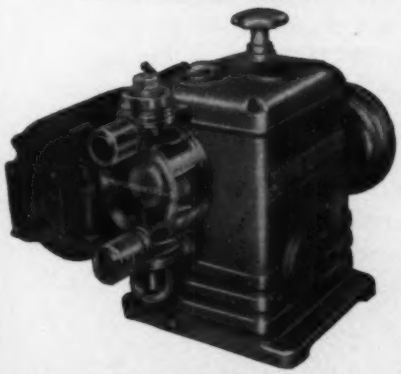
PACIFIC FLUSH TANK CO.

SEWAGE TREATMENT EQUIPMENT EXCLUSIVELY SINCE 1893

4241 RAVENSWOOD AVENUE CHICAGO 13, ILLINOIS

NEW YORK ● LOS ANGELES ● SAN FRANCISCO ● CHARLOTTE, N. C. ● DENVER ● TORONTO

Does YOUR Pumped Water Supply Need Treating?



%Proportioneers% New Improved Heavy Duty Chem-O-Feeder. Positive displacement diaphragm type pump with feeding rate instantly adjustable while pump is operating. Has plastic "See-Thru" reagent head and many exclusive features. Capacity 0-8 gals./hr. against pressures 0-100 lbs./sq. in. Also available in duplex and triplex models.

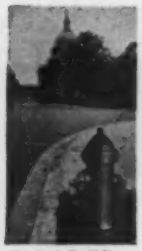
Here's the simple water treating system that's worth looking into . . . whether you pump a few hundred or a million gallons per day. %Proportioneers% Heavy Duty Chem-O-Feeder treats your water supply automatically, dependably. You can feed almost any water treating chemical — hypochlorite, polyphosphates, coagulants, pH control chemicals, or slurries. No more attention is required than filling the chemical reagent tank periodically — the Chem-O-Feeder runs in unison with the water pump and provides the exact chemical feeding you need.

Write today for Bulletin SAN-7 and get the whole story — you'll find %Proportioneers% equipment fully meets your every requirement and saves you money.

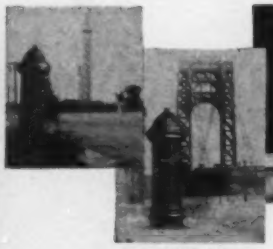
% PROPORTIONEERS, INC. %

9 N. CODDING STREET, PROVIDENCE 1, R. I.

Many are the reasons why Smith hydrants are used by America's leading cities



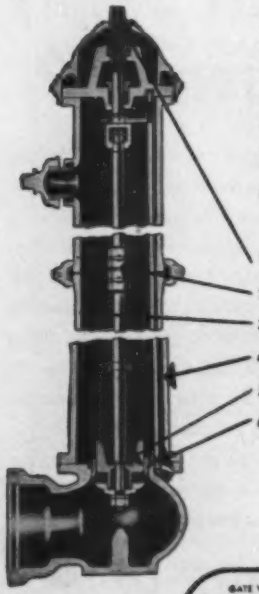
Capitol Building, Wash., D. C.



George Washington Bridge, N. Y.

Independence Hall, Phila.

Empire State Bldg., N. Y.



New York—Philadelphia—Washington—Baltimore—St. Louis—Providence and scores of other cities throughout the nation use SMITH hydrants—and not without good reason. A few of these reasons can easily be seen upon inspection of the hydrant section shown at the left.

1 Working parts easily removed from top.
2 Frangible couplings for collision protection.
3 Maximum flow due to large stand pipe areas.
4 Tapered, frost-proof barrel
5 Compression-type valve.
6 Positive action drain—always closed when main valve is open.

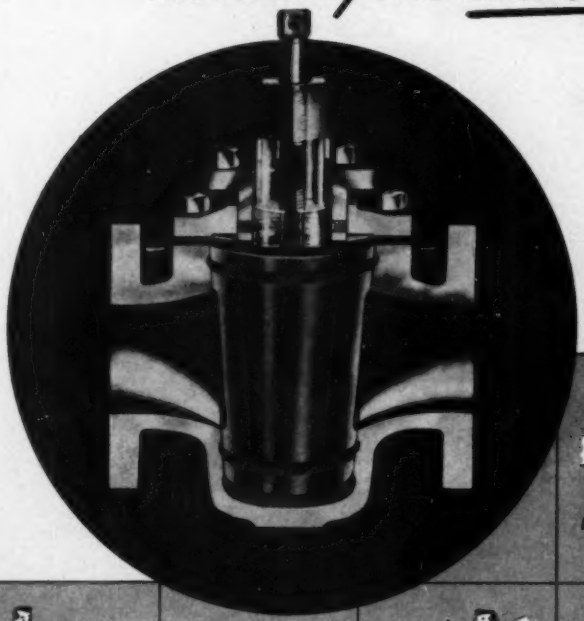
31

GATE VALVES
CHECK VALVES
FIRE HYDRANTS
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.
ESTABLISHED 1877
EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

IN NO OTHER VALVE — *So many features and every one IMPORTANT!*



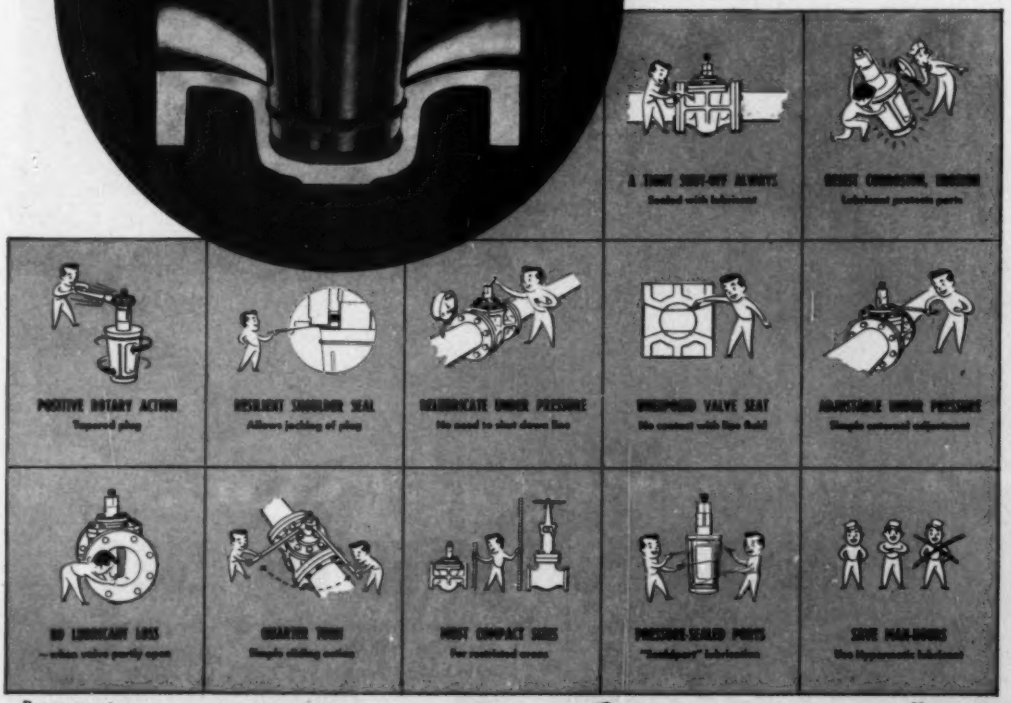
For

SEWAGE DISPOSAL

SERVICES

the unsurpassed valve

KEEP UPKEEP DOWN



Pressures to 15,000 lb test

Sizes— ½ to 30 inch

Nordstrom

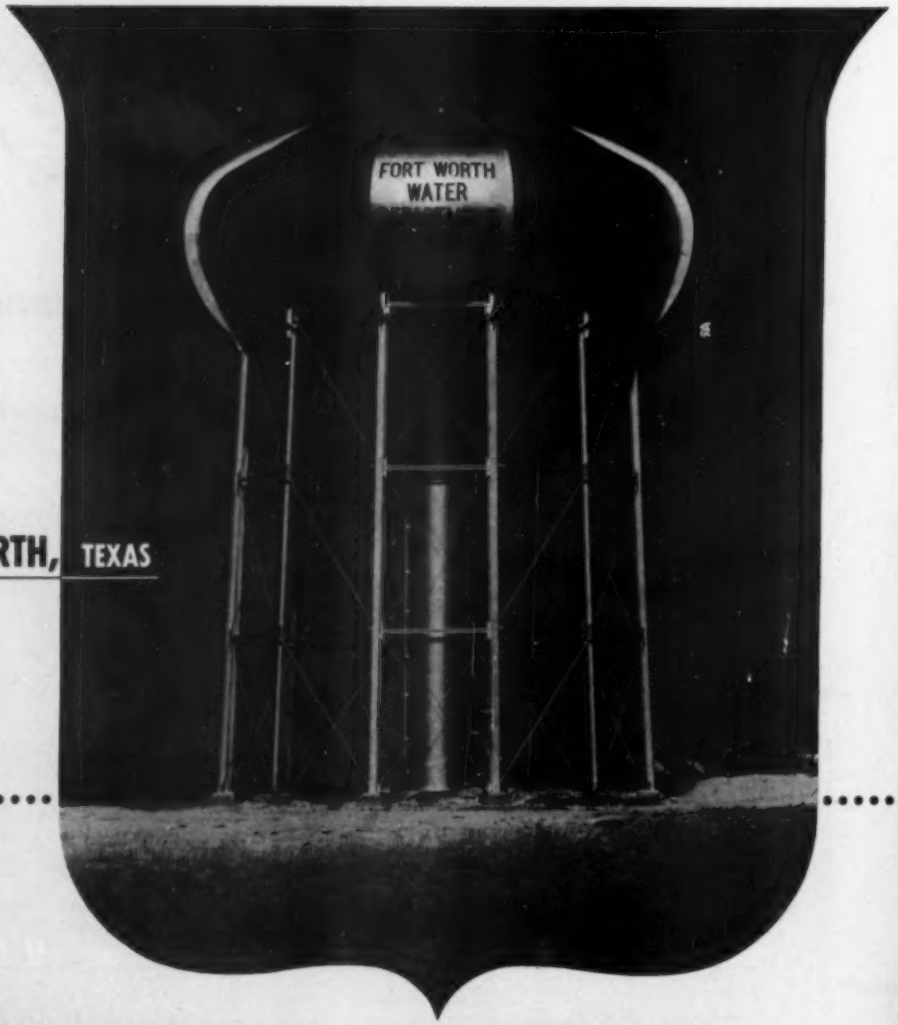
LUBRICATED VALVES

***Nordstrom Valve Division*—ROCKWELL MANUFACTURING COMPANY**

400 North Lexington Avenue • Pittsburgh 8, Pa.

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses
Export: Rockwell Manufacturing Co., International Division, 7701 Empire State Bldg., New York 1, N. Y.

This servant
wears
a Crown
—at
FORT WORTH, TEXAS



PITTSBURGH • DES MOINES

Elevated STEEL TANKS

New beauty . . . new efficiency in large-capacity elevated tank design by Pittsburgh-Des Moines! This handsome *Obloidal* Elevated Steel Tank stores 1,000,000 gallons of water with a head range of 25 feet. 88 feet in diameter, on an 88-foot tower, the gleaming crown of this new tank is visible new evidence of *modern water storage* for Fort Worth.

Do you have our new Elevated Steel Tank brochure?

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

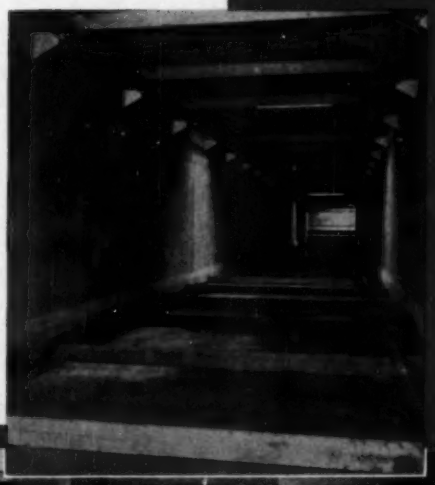
Sales Offices at:

PITTSBURGH	3418 Neville Island	DES MOINES	919 Tuttle St.
NEW YORK	Room 918, 270 Broadway	DALLAS	1223 Praetorian Bldg.
CHICAGO	1222 First National Bank Bldg.	SEATTLE	926 Lane Street
	SANTA CLARA, CAL.	625 Alviso Road	

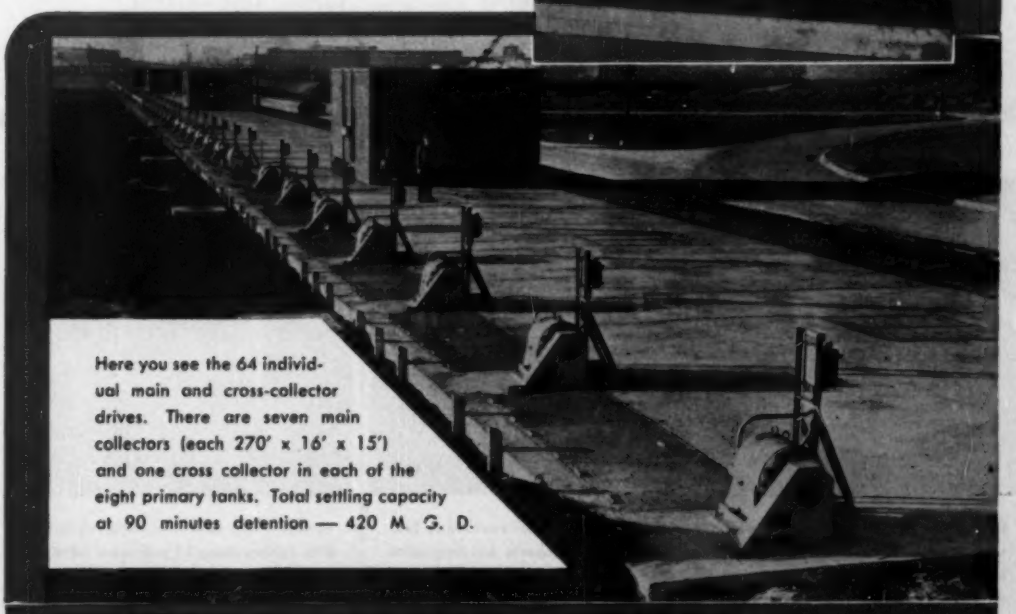
one of the LARGEST . . . but Modern

Completely equipped by Jeffrey in 1939, the Detroit sewage treatment plant is still one of the most modern and up-to-date in the country today. Rectangular sedimentation tank design was adopted since scale model tests demonstrated their superior hydraulic efficiency. Jeffrey primary collectors, bar screens, belt conveyors, screenings grinders, scum removers and grit collectors are all doing a good job of it . . . as in other large Jeffrey-equipped plants. Our Sanitary Engineering Division is prepared to offer information on our line of proved equipment and plant design.

• • •



Right — view through one of the 270-foot main sludge collectors. There are fifty-six main collectors in the primary settling tanks. Space does not permit showing the six bar screens and the twelve grit collectors, designed for maximum flow of 900 M. G. D.



Here you see the 64 individual main and cross-collector drives. There are seven main collectors (each 270' x 16' x 15') and one cross collector in each of the eight primary tanks. Total settling capacity at 90 minutes detention — 420 M. G. D.

JEFFREY ESTABLISHED 1877

G-E CO-ORDINATED EQUIPMENT PAYS OFF AT JAMAICA PLANT

For seven years, this modern General Electric equipped sewage-treatment plant near Jamaica, N. Y., has been serving a large section of the Borough of Queens, New York City. The plant now has a capacity of 65 million gallons, but ultimately it will treat 100 million gallons daily as a major part of the city's $200,000,000 pollution-control program.

G-E engineers, familiar with the problems of sewage disposal, co-operated with New York City engineers in co-ordinating and installing electric equipment at Jamaica. Because of this, G-E equipment has, since its installation, been giving efficient and economical service in every stage of treatment—from screening and pumping to sludge digestion and power generation.

Whether you plan a big or small installation, you'll profit by contacting your G-E representative early. Let him help you plan your electrical layout. You'll find the nearest G-E office listed in your 'phone directory. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

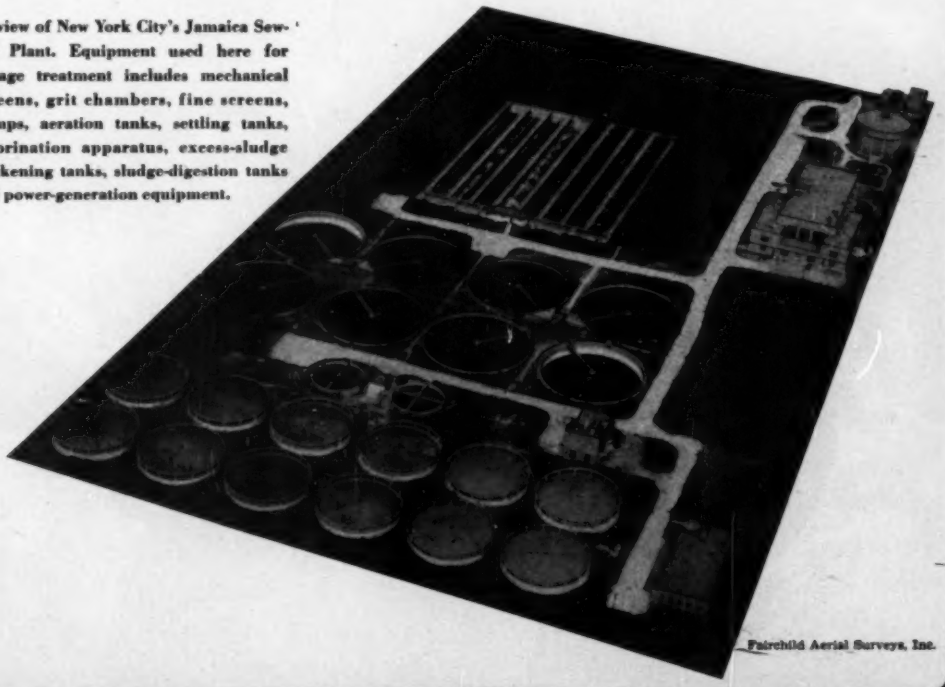
In the Sludge Pumping Chamber, where explosive gases are a constant hazard to equipment, these explosion-proof controllers insure positive operation of sludge-pump motors.

These G-E totally enclosed, fan-cooled, 15-hp motors are coupled to hot-water-circulating centrifugal pumps for heating buildings, and sludge in sludge-digestion tanks.

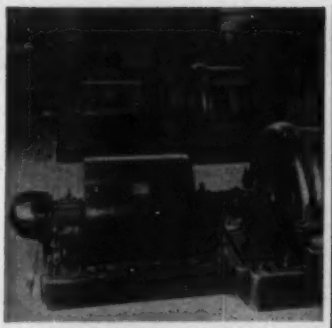
At the "front lines" of the process, G-E submersible, 2-hp motors drive bar screens. Subjected to constant dripping and occasional submersion, these motors have given high-continuity service for seven years.

GENERAL ELECTRIC

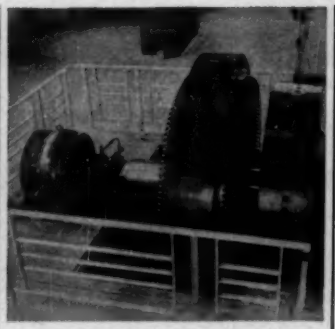
Airview of New York City's Jamaica Sewage Plant. Equipment used here for sewage treatment includes mechanical screens, grit chambers, fine screens, pumps, aeration tanks, settling tanks, chlorination apparatus, excess-sludge thickening tanks, sludge-digestion tanks and power-generation equipment.



Fairchild Aerial Surveys, Inc.



In the operating room of the Blower and Power Building, these G-E 700-hp, 3-phase, variable-speed motors drive centrifugal blowers for aeration in the activated sludge treatment.



Shown here is one of three G-E 1250-kva, 3-phase, synchronous generators used to supply blower motors and auxiliary equipments. Gas from sludge-digestion tanks feeds gas-engines which drive generators.

G-E drawout metal-clad switchgear is used in control of incoming feeders, pumps, capacitors, transformers and generators. Here is an installation in the Pump and Screening Building.

GE CO-ORDINATED SEWAGE-PLANT ELECTRIFICATION

Painted for U. S. Pipe & Foundry Co. by Dean Cornwell

U.S. cast iron PIPE

You have heard it said that "cast iron pipe is cast iron pipe"—a pipe that gives dependable, long-lived, low-cost service—no matter who makes it. And that is basically a true statement. Why then do we have customers who have regularly purchased from us for over 50 years? One reason is that we have pioneered developments that have resulted in process and product improvements over the years, just as today, through research and development, we strive still further to improve our product. Another reason is that we have been able to give our customers the type of service needed to meet their particular requirements. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey. Plants and Sales Offices Throughout U.S.A.**

"Every individual connected with water purification or sewage works should subscribe to this publication. I have introduced it to a host of friends in this field"

Testimonials such as this from subscribers to WATER & SEWAGE WORKS really tell the story. The man who reads and uses the magazine as an aid in his work knows how much it will benefit other workers in the field.

The great REFERENCE & DATA issue alone is worth more than the yearly subscription rate. In it you will find formulae, charts and illustrations covering information not obtainable in any other one source.

Supply of 1949 REFERENCE & DATA number is limited. If you are not a subscriber send your order today!

WATER & SEWAGE WORKS
22 West Maple Street
Chicago 10, Ill.

You may enter my order for 1 yr. @ $2.00 ☐
☐ Include R&D issue 2 yrs. @ $3.00 ☐
Check enclosed ☐

Send bill to.....
My title is.....
Address.....
City..... Zone.....
State.....
(Add $1.00 per year for foreign postage)

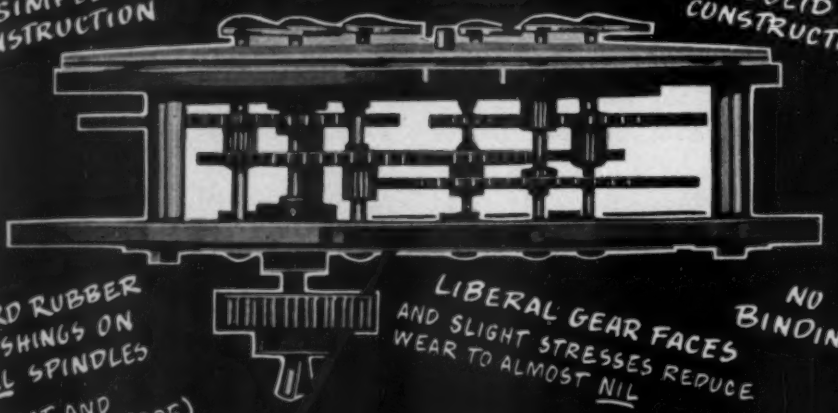
- *If you are interested in the water field only you get all the authoritative data on this subject.*
- *If you are interested in sewage problems only you are kept fully informed and given much help in this field.*
- *If you are interested in both subjects you get all the information in this one monthly magazine.*

Why TRIDENT Meters LAST LONGER and KEEP THEIR ACCURACY!

(1.) THE REGISTER

SIMPLE CONSTRUCTION

SOLID CONSTRUCTION



HARD RUBBER BUSHINGS ON ALL SPINDLES (HEAT AND CORROSION PROOF)

LIBERAL GEAR FACES AND SLIGHT STRESSES REDUCE WEAR TO ALMOST NIL

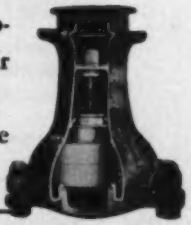
NO BINDING

NO BOLTS – NO SCREWS

50 YEARS OF INTERCHANGEABILITY

THE simplicity and the solid construction of the Trident Register is typical of the entire Trident Meter. Made of the finest materials; gauged, checked and rechecked for absolute accuracy at every point in their production, these rugged precision instruments retain their high accuracy during many years of operation.

You can't beat Trident Meters for maximum revenue and minimum maintenance costs.



New improved parts in old Trident Meter

NEPTUNE METER COMPANY • 50 West 50th Street • NEW YORK 20, N.Y.

Branch Offices in Chicago, San Francisco, Los Angeles, Portland, Ore., Denver, Dallas, Kansas City, Louisville, Atlanta, Boston.

NEPTUNE METERS, LTD., Long Branch, Ont., Canada

212

WATER & SEWAGE WORKS

Vol. 97. No. 3 March. 1950

A Gillette Publication

IMPROVING THE WATER SUPPLY OF SYDNEY, AUSTRALIA

by

H. BOWDEN FLETCHER

U.T.P.S. Correspondent
PUNCHBOWL. NEW SO. WALES

IN ITS long range plan to supplement the existing water supply to the City of Sydney and at the same time improve the distribution to the consumer the Metropolitan Water, Sewerage and Drainage Board (M.W.S.B.) is at the present engaged on three works of major importance, viz.:—1. Erection of Warragamba Dam, the largest in the Southern Hemisphere. 2. The addition of a new pipe line from the Warragamba pumping station to the Prospect Reservoir (the key dam in the distribution system). 3. The driving of a new pressure tunnel from the near city reservoirs at Potts Hill to one of the main pumping stations at Waterloo a distance of 10.4 miles. In this article it is proposed to deal with the work on the pipeline and pressure tunnel, which are of the most urgent nature and from the completion of which it is hoped to overcome the existing shortages which take place every summer when the peak demand occurs.

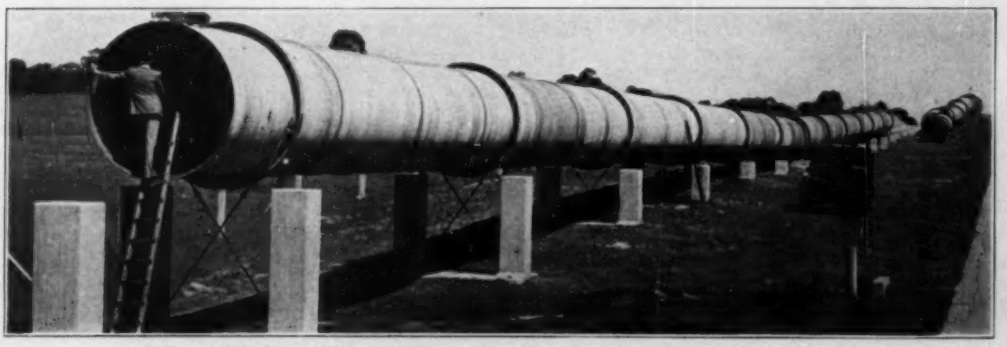
WARRAGAMBA-PROSPECT PIPE LINE

During a period of prolonged droughts before the war, the Metro. Water, Sewerage and Drainage Bd. decided to proceed on the first development of the Warragamba River catchment, the next source available after the Nepean River Catchment, then fully developed. It accordingly constructed an emergency scheme comprising a 48 in. steel main from an impounding weir and an underground pumping station to convey water from the Warragamba River to the service reservoir at Prospect.

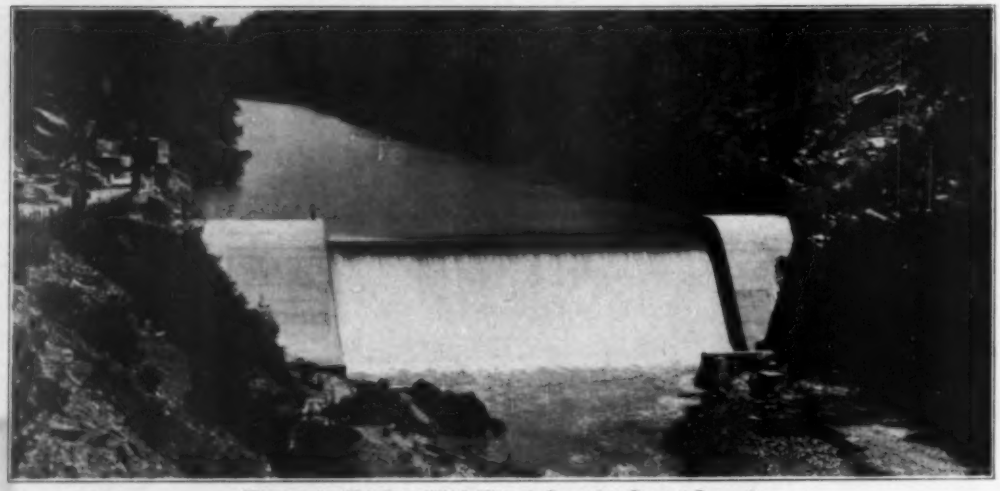
The pipe line has a capacity of 40 mgd. but is much below the pumping capacity of the six 1,000 hp. motors and centrifugal pumps installed in the 173 x 22 x 37 ft. excavated rock cavern 180 feet below ground level.

As part of the long range development plan of the Warragamba catchment, which includes the erection of one of the largest dams in the Southern Hemisphere, the Board is now engaged in the construction of a new main parallel with the existing 48 in. main. This consists of 2½ miles of 106 in. dia. pipes from the dam site through the pumping station to the Nepean River crossing and 14½ miles of 84 in. dia. pipes from there to the Prospect Reservoir. Eventually there will be two 106 in. mains on the first section and three 84 in. dia. mains on the second portion.

Work on this new main commenced in 1942 with the driving of a tunnel from a site near the existing emergency weir on the Warragamba River to the Nepean River Crossing and the driving of six shorter tunnels, excavation on formation work



Section of 84-in. Pipe of Warragamba-Prospect Line Being Placed on Concrete Sills for Welding



Warragamba Weir From Which Water is Pumped to Prospect Reservoir

over the remaining section. However, as men were more urgently required on important war work, operations eventually ceased in 1944 and were not again resumed until 1946 under the direction of the permanent Engineering staff of the Board. As men have become available the construction work has been stepped up to the full extent possible.

Main Tunnel Construction

Work on the 106 in. dia. main tunnel 1¼ miles through sandstone has been completed to the Nepean River Crossing and the laying of the concrete lined steel liners commenced. The excavations for the Nepean River Crossing have also been finished and ready for pipe-laying. This work has been delayed, as the job has had to be done piecemeal due to intermittent flooding of the River.

The excavation of the tunnel was carried out by boring and firing the whole face. A centre cut was blasted first and after a lapse of about six seconds the remainder was blasted in five relays, delayed action detonators being used. Boodling was done almost entirely by hand, although a scraper loader was employed in the final stages of the job. Approximately 2½ lb. of explosive were used per cubic yard.

Only one shaft was sunk to the tunnel drive but to facilitate the work, four adits were driven from the existing tunnel which carried the 48 in. main and use was made of the shafts already in existence on that tunnel. The actual shaft sunk measured 16 ft. x 12 ft. and the three existing shafts on the 48 in. main tunnel were increased to those dimensions. The adits were cut to the same size as the main tunnel 11 x 11 ft.

The 106 in. liners are delivered in 10 ft. lengths and are lowered down the shafts in a bridle sling on to the pipe carrying truck which is propelled to the face by an electric loco. Where the shafts are connected to the tunnel by an adit the liners are lowered on to a special truck and taken to the tunnel where the truck is swung on a turn table to bring the liners to the correct relative position before transport to the face. Tracks in the tunnel were normal 2 ft. laid with 40 lb. rails.

On arrival at the face the forward end of the pipe is jacked up to the approximate position for marrying with the pipe already in position, the truck is then moved forward and pipe jacked up and wedged into final position to line and grade. At one face two pipes are placed and then concreted and at the other face three pipes are placed before concreting.

Concreting arrangements differ at each face; for instance, at one face the aggregate is fed from the surface through a 6 in. hole drilled in the sandstone into containers carried on conveyor trucks. The trucks are conveyed by electric loco to a mixer at the face. Here the concrete is fed from the mixer by automatic hoist to the hopper of the concrete pump by which it is deposited round the liners.

At the other face the concrete is mixed on the surface and fed via a 6 in. pipe line to the concrete pump in the tunnel which in turn pumps it some 800 ft. along the tunnel to the face. Concrete packing is all done by hand.

Electric power is available in the tunnels for driving the mixers and concrete pumps at 415 volts whilst lighting is on 50 volts in all underground workings.

The completion of this 106 in. main was scheduled for June 1949. The steel liners are lined with 2 in. centrifugally spun cement mortar and have formed spherical ball and socket ends. This permits adjoining liners to partially overlap and be welded together. After placing the concrete backing will be of a minimum thickness of 7 inches. After welding is complete the gaps left in the cement lining at each joint are made good. Plate thickness of the pipes varies from 7/16 to 11/16 in.

84-in. Section

All the tunnelling and most of the open cut excavation for the 84 in. section of the main has been completed and where the pipe line will be laid on the surface the concreting of the pipe sills is being proceeded with, ready for the delivery of the pipes in their 45 ft. lengths.

To assist in the rapid movement of plant and the disposal of the spoil a concrete road was constructed between the old 48 in. main and the new work in progress. This permits scoops, self propelled equipment and trucks to operate at maximum speeds irrespective of weather conditions.

Steel liners in 10 ft. lengths have been placed in all the tunnels on this section and have been concreted in position. For this work 10 ft. lengths were lowered by a 10 ton Bay City mobile crane on to a specially designed trolley, running on tracks laid in the bottom of the cut. This trolley

was then pushed into the tunnel to the position required and the end raised so that jacks could be placed under the pipe while the marrying operation was effected. For concreting between liners and excavation limits the portable type mixer was stationed on top of the tunnel portal and the mix fed via a chute to skips which were then trucked to position.

The rate of lining in the 84 in. dia. pipe tunnels averaged one 10 ft. length per tunnel per day including the setting into position and concreting but when the delivery of the 45 ft. lengths commences the rate of laying is expected to be 135 ft. or better per day at each laying point. Each of the 45 ft. long pipe sections weighs up to 17 tons.

Excavation Machinery

During the excavation and tunneling work heavy machinery has been used to the fullest extent to expedite progress and reduce the overall cost of the work. Actual type of plant used was selected in relation to the type of ground met with. Where clay and soft shale predominated power shovels, LeTourneau 14-yard self-propelled scrapers and 8-yard carry-all scoops have been found most effective. On the long leads, particularly those of over 200 yards, and under dry weather conditions LeTourneau self-propelled scrapers were found most efficient. Sixty hp. tractors fitted with dozers have been used for blading the batter toes thus enabling the scoops to operate more effectively. This equipment was also used for blading the drainage drains at the top of the batters.

The 1 to 1 batters have been trimmed by hand and heavy tractors have been used to haul cable controlled scrapers to the spoil dumping points after loading in deep cuttings. Spoil has been dumped either on resumed ground adjacent to the line or used as required to build dams on water courses in the vicinity for the benefit of the farmers who desired them.

Open cuts on this 84 in. section range up to 40 ft. deep, 16 ft. wide at the bottom, with a 1 to 1 batter. Some trouble has arisen with erosion of the batter faces by stormwater but also due in some cases to disturbance of the subsoil. To prevent any further trouble in these directions concrete retaining walls have been constructed where considered necessary and adequate drainage has been provided at the top of the banks.

The 84 in. pipes are in 15 ft. lengths where used in concrete anchor blocks and as previously mentioned in 45 ft. lengths for normal laying. The 45 ft. lengths together with the intermediate 15 ft. anchorage lengths at each end are placed in position and welded together, by mobile welding outfit, to form a continuous tube 560 ft. 6 in. long with expansion joints at the middle of each length. Apart from the double support at each anchor these 560 ft. lengths will be supported at 49 ft. 9 in. intervals by rocker plates, permitting free movement for expansion and contraction of the steel. The design of the joint, in which only cement lining or stainless steel is exposed to water, should prevent any internal corrosion of the pipes which vary in thickness from 3/8 to 9/16 in.

The total weight of pipes used in the whole of the new main will be approximately 20,000 tons. Some 500 men have been constantly employed, quartered in four camps at different parts of the job.

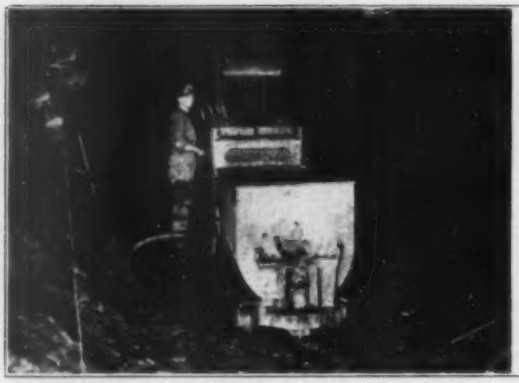
Control Valves

The pipe line will be fitted with four manually-controlled sectioning valves at approximately 4 mile intervals. The first of these is also designed for automatic closing and the final valve at Prospect end will be under remote control from the pumping station at Warragamba. Manholes 24 in. in dia. at approximately ¼ mile intervals, scours (15 x 18 in. dia.) to the number of 15 and air valves in groups at about ½ mile intervals (36 groups in all) are also provided for.

Subject to the delivery of the pipes from the contractor on schedule and no unforeseen delays it is anticipated that the whole line will be completed by September 1950 and ready to deliver 120 mgd. to Prospect Reservoir. Prospect Reservoir is the main holding dam for the City of Sydney distribution system and all the existing storage dams on the Nepean Catchment area feed through this dam.

The hydraulic gradient of the line is R/L 240 at the weir and R/L

Super C Tournapull and LP Carryall Loading During Excavating on the Warragamba Pipe Line



City Pressure Tunnel

(One of seven Sullivan Loaders—Type HL-20. Uses 225 cu. ft. of air per min. Loading capacity 9 cu. ft. per min.)

Existing Warragamba-Prospect Line

(Existing tunnel with the 48-in. main between Warragamba and Nepean River. New tunnel to house 106-in. main is being driven parallel to this one.)

198.5 at Prospect, a fall of 41.5 ft. along the 85,000 ft. of the line. The outlet of the existing 48 in. main into the Prospect Reservoir is of closed tunnel type with a sluice trap. The new 84-in. main will discharge from its closed tunnel into an open concrete channel some 200 ft. long leading to the reservoir.

THE NEW PRESSURE TUNNEL

In its long range programme to provide effective distribution of water to the consumer for the next 50 years the M.W.S. Bd. of Sydney is now busy on the construction of a tunnel from Potts Hill reservoirs at Bankstown to one of its main pumping stations at Waterloo, one of the larger industrial suburbs, a distance of 10.4 miles.

This conduit will duplicate the existing pressure tunnel and is designed to draw its supplies from a large service and storage reservoir located at Potts Hill, fed from the Nepean and Warragamba catchment systems. It is expected to cope with the growth of consumption demands until 1985 and any increased demand beyond that period will be obtained by the use of booster pumps. Named the City Tunnel, it will ultimately supply additional water to subsidiary reservoirs in the Western, Southern and Eastern suburbs of Sydney.

Modern Tunnelling

The job is claimed to be a splendid example of modern tunnel driving and mining techniques. It has been the aim to employ a maximum of mechanization in the construction in order to conserve such labor obtainable and to gain the advantage of more rapid operation thus reducing the cost and enabling improvements to me made in the working conditions of the men engaged.

At each of 13 shafts the plant consists of all the necessary machinery for excavation of the rock or shale, transporting it to the shaft, elevating it to the surface and placing it in motor trucks for disposal.

The actual tunnel is in two sections, the upstream of 27,542 ft. to shaft No. 7 being to suit 96 in. dia. liners, and the downstream half, of 27,404 ft. from shaft No. 7 to shaft No. 13 to suit 84 in. liners. In the total length of 54,946 ft. some 25,611 ft. are being excavated in sandstone, 29,009 ft. in shale whilst 328 ft. of the upstream approach will be in open cut.

It is estimated that the quantity of excavation will be 202,585 cu. yd., comprising 6,765 of soil, 118,431 of shale and 77,389 of sandstone. To minimize risk to surface structures, due to blasting, a minimum cover of 50 ft. has been adopted in the design, but with this governing consideration, the depth has generally been kept to a minimum consistent with construction requirements. Maximum grade of the tunnel will be limited to 1 in 100 and the minimum grade to 1 in 2,000.

The 13 shafts along the route of the tunnel comprise one intake, one uptake, five construction and six off take of which two are unwatering shafts. The maximum cross-sectional area of the shafts is 695 sq. ft. (33 ft. 6 in. x 20 ft. 6 in.) and the minimum 217 sq. ft. (15 ft. 6 in. x 13 ft. 9 in.) the areas varying in accordance with the particular requirements for downcast, upcast, construction, dewatering or offtake purposes.

Mechanized equipment is used entirely for tunneling and comprises drills, mounted on jumbos, loaders and 30 cu. ft. mining trucks hauled by electric locos.

Removing Broken Rock

After firing, the broken rock or shale is handled by a mechanical loader operated by compressed air and running on a 2 ft. gauge track. It is an overhead type of loader with a capacity of 30 cu. ft. per minute.

A single central 2 ft. gauge 45 lb. rail track is placed along the centre of each tunnel. On each side of the shafts a long turnout connects up the double cage tracks and allow for shunting and passing of the mining trucks as well as movable plant. Two turntables at each shaft provide for turning large or heavy machines. Passing loops are provided at intervals on top of the single track but will be kept within 30 ft. of the trucks during boodling. Ahead of the portable loop the loader will operate on the central track, loose rails being pushed forward into the spoil to carry the leader forward as the cleaning up proceeds.

For hauling the mining trucks along the tunnel 3 ton locos with a speed of 4½ mph. are used, driven by 60 volt direct current storage batteries which are recharged each day by selenium rectifiers situated in underground charging stations recessed in the side of the tunnel near each shaft.

When the full mining trucks arrive at the shaft, some of which are over 200 feet deep, they are loaded singly into a cage and raised to brace level, an empty truck being taken down in the descending cage. Manpower used in trucking and tipping into spoil bins has been almost entirely elimi-

nated and considerable time saved by mechanical installation.

Timbering and Lining

In shafts, close timbering with 2 in. runners and 1 x 8 in. sets are used in shale, skeleton sets only being used in rock to support services and cage guides. In shale tunnels 8 x 2 in. hardwood logging supported by 45 lb. rails at 4 ft. centers is used. The rails are bent to tunnel shape in a specially designed plant.

From shaft 1 to shaft 7 steel liners of 8 ft. 4 in. internal diameter lined with 2 in. of mortar and from shaft 7 to shaft 13 steel liners 7 ft. 4 in. lined with 2 in. of mortar are to be welded in the tunnel. All joints are welded in situ and the liners vary in thickness from 7/16 to 9/16 in.

The space between the liners and the walls of the tunnel will be filled with concrete by means of a concrete pump whilst the aggregates will be mixed at the bottom of the shafts and the concrete mixed en route in special "transit" mix trucks.

Removal of Spoil

During mechanical loading the spoil bank is kept wet by hosing and at least once in every two weeks dust counts are taken by the Owens Dust sampler during each operation at every working face throughout the tunnel.

The soil bins are wooden structures divided into two steel lined compartments each capable of holding 40 cubic yards of loose spoil which is the maximum output per face per shift at each shaft. The spoil is discharged through a steel chute.

The spoil is carried to the disposal points by motor trucks owned by councils and other public corporations (at no cost to the Board) who use it for filling and other work of reclamation.

Service in Tunnel

For servicing within the tunnel itself there is a 4 in. air main, 1½-in. water main, 415 volt power line, telephone cable, 32 volt line for lighting, ventilation duct and shot firing cable all of which are supported on steel brackets on the tunnel walls.

Compressd air is supplied by electrically driven compressors providing at the receiver a pressure of 95 lb. per sq. in. The number installed at each shaft varies from 1 to 3 according to the demand for air. The compressors are fitted with filters which, in addition to clearing the air and slightly increasing the mechanical efficiency, act very well as silencers. After being compressed, the air is passed through an evaporative cooler which reduces temperature and thus throws down most of the water and oil carried in vapour. Air cooling also permits delivery of a greater quantity of air to the pneumatic machines at a given working pressure than would be possible with air uncooled. The general efficiency of the machines is therefore increased.

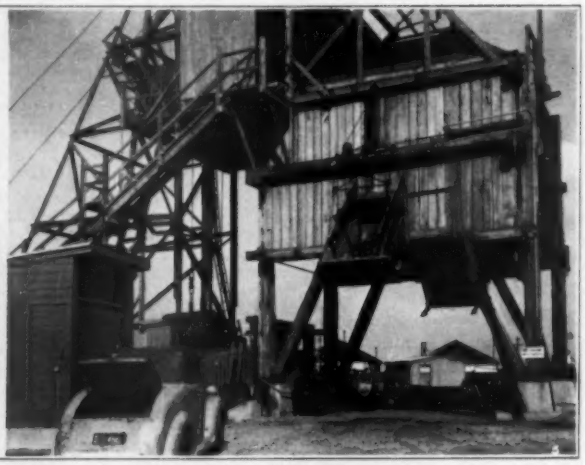
Safety Measures

Adequate safety measures have been incorporated to guard against rope breakage or overwind. Should a rope break, automatic mechanism on the cage grips the skids and prevents the cage dropping to the bottom of the shaft. Limit switches on the winder cut off power from the controller should overwind occur. If the limit switch fails and the cage travels too high a safety device just above the cage hooks into a casting at the top of the head tower, detaches the hauling rope and leaves the cage suspended.

The ventilating system at each shaft is operated by a centrifugal fan driven by a 25 or 35 hp. speed motor (460, 720, 970 and 1,460 rpm.) and arranged for exhaust or plenum through 20 in. diam. duct. Dampers at the shaft provide for adjusting the quantity of air exhausted from

Warragamba Pumping Station on Warragamba-Prospect Line
(Will provide water to new pipe line under construction in parallel with existing 48-in. line.)

Lowering 108-in. Pipe Section
(Tunnel Access shaft on Warragamba-Prospect Line.)



Shaft Top on City Pressure Tunnel
(Spoil bins with chute for loading spoil trucks. At left is the fan house.)

or delivered to each face. Venturi tubes with direct reading manometers are installed to indicate the quantity of air being passed through each duct. The fans are enclosed in sound absorbing houses and will exhaust air at the rate of 6,500 cu. ft./min. after firing, and at 3,000 cfm. at each end of the drive for normal operation. In other words outside air is supplied to the tunnel at a minimum rate of 300 cfm. per man per minute.

Under the direct control of the chief foreman two selected miners are constantly employed, examining all shafts and tunnels for dummy rock, dangerous ground and inspecting all timbering.

Normally the labor employed at each shaft comprises a team of 25 men, allowing 8 per cent for absenteeism. Special attention has been given to the comfort of the workmen by the provision of amenities and safety factors.

Drinking bubblers and first aid facilities are located within the tunnels at frequent intervals whilst at each shaft, on the surface, are located fully equipped first aid sheds, comfortable and hygienic buildings to handle messing and changing, drying of working clothes, hot and cold showers, lavatories, etc. Electric heaters supply hot water for tea, whilst fans and electric radiators are provided to ensure the working clothes are thoroughly dried before the start of the next shift.

The whole of the work is carried out under the supervision of Engineers on the permanent staff of the M.W.S.B. and by a nucleus of permanent employees with the addition of temporary labor as they are required. The plant used is owned by the Board which has one of the most comprehensive collections of heavy equipment for all types of construction work needed for water conservation and distribution, sewerage and drainage works, existing in any organization in Australia. The Board seldom, if ever, lets out major works such as dams, tunnels, etc., on contract, much preferring to use its experienced staff in handling these construction projects.

E. W. Steel Appointed Prof. Sanitary Engineering at University of Texas

The University of Texas has announced the appointment of Prof. Ernest W. Steel as Professor of Sanitary Engineering effective February 1st, 1950. He will take full charge of the sanitary engineering curriculum and research in this field.

Formerly Prof. of Sanitary Engineering at Texas A. & M. College from 1925 to 1942 when he entered the Army, Mr. Steel comes to the University from Caracas, Venezuela, where for the past few years he has been serving as consultant to the Venezuelan Government on water supply and sewerage problems.

Mr. Steel obtained the degree of Civil Engineer at Cornell Univ. in 1920 and in 1928 was awarded the Fuertes Model by his Alma Mater. He served with the U.S. Engineers in both World Wars completing his service in World War II with the rank of Colonel. From military duty he went to Venezuela as a Chief of Field Party for the Institute of Inter-American Affairs and remained as consultant to the Venezuelan Government on water supply and sewerage matters.

Professor Steel is the author of several books, amongst which are "Water Supply and Sewerage," "Municipal and Rural Sanitation," "Municipal Affairs," "Hygiene of Community, School and Home" and has contributed to "General Engineering Handbook," and was editor of the "Texas Manual for Water Works Operators." He has also contributed articles to several technical magazines, including *Water & Sewage Works.*

Dr. H. Hyde Director Inst. Inter-Amer. Div. of Health

The Institute of Inter-American Affairs has announced the appointment of Dr. H. van Zile Hyde as Director of its Division of Health and Sanitation. Dr. Hyde who comes to his new post from the U.S. Public Health Service, where he has been a medical officer since 1941, will succeed Clarence I. Sterling who resigned to become Director of the San. Engr. Div. of the Mass. Dept. of Health.

HEADACHES, HUNCHES AND HARD WORK

Pages from the Life of a Superintendent

by

M'KEAN MAFFITT

Retired Supt. of Water & Sewage Wks.
WILMINGTON, N. C.

IN the early part of 1899 having quit the public schools of a small Southern city I started looking for a job. I knew there was no chance of going to college, so work was the next best thing. But, as my reputation was not the best, there were no jobs available. Time after time I received the "No Job" brush off, yet lated some other boy was employed. Awakening to the fact that I had to prove my worthiness I went to the Water Works Office where my older brother was employed. Taking off my hat and coat I started to clean up the office. I swept the floor, brushed out the corners, dusted off the books and polished the brass spittoons. I must have made a good job of it, because later, when the Superintendent came in he inquired of the bookkeeper as to who had done the cleaning job. I think he especially noticed those spittons—and, don't think they weren't an important adjunct in those days.

Well, that was my start in the Water Works game. For ninety days I worked at the job that a careless colored janitor had half-way done. Then I was invited to visit a country boy friend and spend a couple of weeks with him. When I asked permission to be let off I was informed that, since I had been working without pay, my request was granted. After three days of the fishing trip I was recalled to clean up the office, the darky janitor having done another bad job. To my great delight I was informed that I was being placed on the pay rolls at the munificent sum of $2.00 a week. I was overjoyed; I had a job. And, anyway, the fish were not biting.

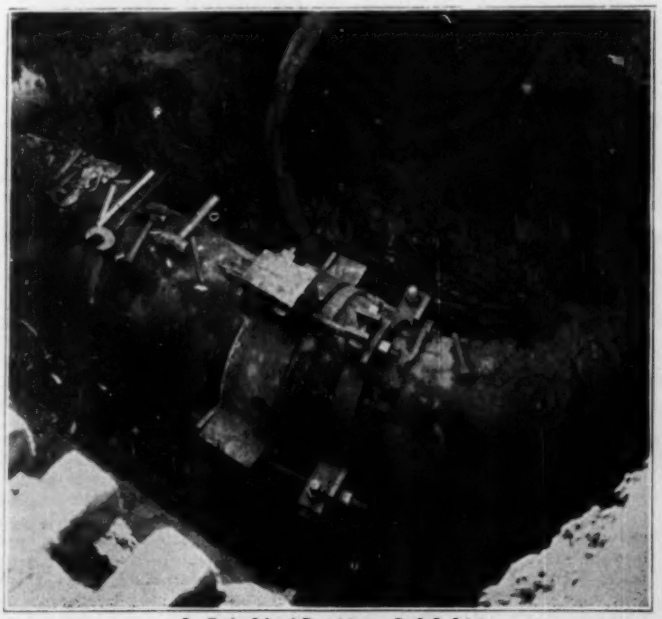
For the next several weeks I cleaned office for a couple of hours a day and helped the bookkeeper with his posting, since everything was done by hand at that time. Then occasionally I helped the Superintendent in calculating his reports as to pounds of coal per million gallons of water pumped, etc. However, I soon realized that this would make me at the very best, "Custodian of the City Hall," with nothing else in sight. So, I inquired of the Superintendent as to the disposition of certain meters that

The Author
Hon. Member A.W.W.A.

the general foreman had condemned as being unfit for repairs. These scrap meters were turned over to me to play with. Thus began my hydraulic studies; or, should I say, my meter experiences.

I took these meters and dismantled them, reassembling them, dismantling and reassemblying them, over and over until I had become familiar with the several makes. There were the old type Thompson Bee, Worthington (plunger type), Hersey Rotary, the Empire and probably one or two others. After several weeks of work and the use of parts from one or the other of the same type I had managed to get some four or five in such condition that the general foreman declared them fit for service. I was commended for diligence and industry.

The first week's pay roll made me rich. I had money to spare. Never had I had that much money before, but it did not last very long. When I went home that Saturday afternoon and showed my mother my wealth she made the suggestion that my younger brother needed a pair of shoes. I saw my money go glimmering, but why worry? I had another Saturday coming in seven days and again I would have two dollars. Incidentally, she tried to persuade me to save a quarter



An Early Job of Repairing a B. & S. Joint
My first real "headache"; cured by a "hunch," a little "hard work," and some loss of sleep. In a difficult spot, this joint hasn't been heard from since.

at least out of each pay envelope. But I could not see it that way, so today I live as I lived then, right to the amount of my income.

After several months of double work, janitoring and helping with the broken meters, the general foreman got drunk once too often and was fired. I remember his drunken actions because he went through all the reports on file which he had signed as General Foreman, scratched out the General Foreman and substituted "Monkey Wrench," saying that since he had never been anything but a "money wrench" he was not going to let his signature stay on record as General Foreman. That taught me a lesson; neither to be a "monkey wrench" nor to get drunk.

When the general foreman was fired all the meter work was placed under my supervision and my pay was doubled—i.e. increased to $4.00 a week. To me this meant big money. My brother was placed in charge of the distribution system maintenance and repairs, thus I had a chance to become familiar with the then methods of maintaining a small water works distribution system. I made the best, or I think the best, of my opportunities.

I Cut My Eye Teeth on a Blowout

About this time we had a blowout in the 12" main feeder to the city. It happened that the original construction of the system had called for one 12" valve just outside the pumping station and another one on the branch line leading to the stand pipe some twelve city blocks away. Thus, a blowout or repair anywhere in the twelve blocks called for the shutting off of the water from the entire city. This particular blowout was caused by having used a 45 deg. bend where a sixty degree turn was made. The difference being made by "cocking" the joint. Since the leak was near the pumping station the surges, or hammer, from the positive displacement pumps had gradually caused a slippage in the cocked joint and it was impossible to properly caulk it so that it would hold. For several days a man was kept on the job day and night so that as the leak would again begin to flow he could immediately recaulk the joint. Meanwhile study was made as to what could be done without having to shut off the water from the entire town while a new fitting was to be cut into the line. Several attempts were made to enclose the whole bell joint in a sheet iron sleeve. This was not successful because the sleeve was not made to the contour of the pipe, and shoulder of the bell. Then I had an idea; or, should I call it "a vision." I conceived of a clamp behind the bell, and a wide false type of bell effect to be clamped to the face of the bell with a lead gasket between. Then when the long bolts were drawn tight the lead gasket on the face of the bell would hold, the false bell would be poured and then caulked, thus making a false joint in front of the bell. It was necessary to make the false bell of heavy cast iron, to exact dimension to fit over the pipe, leaving a one half inch space for leading, and to turn the inner face of the bell to the exact degree of the misalignment of the pipe where it was cocked in the bell of 45 deg. bend. The Superintendent agreed with me that it was worth trying, so I proceeded. The machine shop foreman was a friend, and he helped me with the measurements, etc. Waiting until the wee small hours of a Sunday morning when consumption was low, we had the pumps stopped and then took off the previous protection, placed the clamp, false sleeve and tightened up the bolts, poured the joint, caulked the whole affair including the lead gasket between the face of the bell and face of the false bell portion of the clamp. Our success was immediately apparent. It worked and from that day I have never heard from this joint. Incidentally thirty years later in another location on another system I had the same experience, and a new but larger clamp effect worked very nicely. The accompanying photograph shows the make-up of this type of joint repair.

This is the first of a series of "short-stories" by a Water Works Super, who claims that he learned all that he knows about the Water Works Business "the hard way."

For many years we have known M'Kean Maffit and have many times had the privilege of hearing him discuss water works problems at meetings, conventions, and elsewhere.

We have frequently listened with much pleasure to the philosophy and reasoning of the author, as expressed on the floor of water works meetings and privately. And, we have heard him "preach" a lot of common sense to the younger men and newcomers in the water works business.

We have admired his counselling and his long-time leadership in the North Carolina Section of A.W.W.A., of which he was a founder. And have applauded his "mainspring" efforts, resulting in the strengthening of membership in the Section.

We have taken great pleasure in seeing M'Kean Maffit awarded Honorary Membership in A.W.W.A. And it is a genuine privilege to be able to publish in *Water and Sewage Works* some of his varied experiences during a lifetime of service as first, last, and all the time.—A "Water Works Man."

Filter Overhauling Next

Having gotten all the meters in the system in fairly good order I was given the job of reworking four New York Continental Jewell rapid sand filters. This was about 1903. The system had four wooden tub Continental filters of approximately 500,000 gallons per day capacity each. The underdrainage systems were in bad order and the Superintendent decided to overhaul each in an attempt to increase the then capacity of the filters.

Probably a description of the purification works will make it clearer as to just how these filters worked. We had a raw water pump of volute design that pumped the raw water from a small creek during low flow periods; that is, after rundown of flash flows in order to avoid pumping red clay "soup." This pump discharged into the lower reservoir where we had about 30 days storage. In the upper reservoir we had an additional 40 to 60 days storage. These figures are pure estimates, since there never was, so far as I know, any measurements of capacities. In the lower reservoir we had approximately 30 days presedimentation and the water came to the filters with only a slight milky appearance. From the reservoir the water went to the alum dosage device and then *immediately* to the filters without benefit of coagulation basins. This alum dosage device was very simple. It consisted of two heavy cast iron cylinders about 14" in diameter and some 36" high. There was a flanged top that was easily removable. At the top of the cylinder there was a small inlet from the pressure mains; at the bottom the outlet led directly into the raw water flume. These cylinders were used alternately. When one was in use the other one was refilled with lump alum. Then the inlet water was turned on and the solution, without testing of any kind, was discharged into the flume approximately 12 feet from the first pair of filters, and 30 feet from the second pair. The rate of alum application was a pure guess, though by marking the stem of the water inlet valve we could get a fairly uniform application of the saturated alum solution. Tests for daily operation were made visually, using a clean glass filled with filter effluent. If the water was clear we shut down a wee mite on the alum pot inlet valve. If the water had a tinge of cloudiness we opened the inlet valve a wee mite. Once a month we sent a biological and a chemical sample to Wm. Royal Stokes in Baltimore, Md., who made the biological examination and sent

the chemical sample to Temple University, which I think was in Philadelphia. Thus we would get a report about the 15th of each month as to the condition of the water at the time we took the sample.

The filters were typical round wooden tubs. The underdrainage system was of cast iron pipe with ¾" tapped holes into which had been screwed ¾" galvanized nipples. These nipples were topped with a common tin funnel of about 5" top diameter and these funnels were filled with BB shot. They were capped with sheet tin that had been punched full of nail holes using about a ten penny nail. Quite a good screen, as it turned out to be. The wash water lines discharged into a four-way cylindrical valve that had a vertical sliding lift gate with one opening. Thus when we desired to wash a filter we shut off the effluent pipes, lowered the cylindrical valve gate into position, placed the outlet opening to the quarter section desired and turned on the water. Thus one pie-shaped quarter of the filter was washed at a time. In addition there was a horizontal rake effect over the filter which was turned by water pressure and the rakes were run through the entire sand bed while the wash water was going through only one quarter of the filter bed. Thus there was a residue of sediment left on three of the quarter sections that had been washed already, there being no means of washing the whole filter bed at one time. Yet we had practically no typhoid or other water borne diseases from the use of city water. The finished water was clear and almost sparkling, though little was known about micro-organisms, algae and such like. We had *monthly* laboratory reports of the conditions—so what?

(To be continued)

A NEW TEST FOR HARDNESS OF WATER

by

F. R. McCRUMB*

BALTIMORE, MD.

The total hardness of water has long been determined by the soap test. This test is based on the fact that a lasting lather cannot be produced with soap and water until sufficient soap is added to react with the calcium and magnesium present in the water. The hardness is determined by measuring the quantity of soap required to hold a lather. Standard soap solution is added from a burette to a measured sample of the water in a glass-stoppered bottle. The soap solution is added in small increments and the sample is shaken vigorously after each addition until a lasting lather is formed. The volume of soap solution used is a measure of the hardness.

This procedure is slow and tedious. The sample may require a number of shakings before the end point is reached. The accuracy of the method is influenced by the ratio of calcium and magnesium, the total concentration, the method of shaking, the operator's idea of a "permanent lather," and the stability of the standard soap solution. Several modifications of the soap test have been developed and in the hands of an experienced operator, fairly good results may be secured. However, in routine testing the soap test may frequently give misleading information.

The New Method

A new method of determining the total hardness of water has recently been developed by Schwarzenbach and others at the University of Zurich. This new method is based on the fact that certain organic acids form stable complex compounds with calcium and magnesium. These sequestering reactions can be employed for the determination of hardness in the presence of certain indicator dyes which are red in the presence of calcium and magnesium ions and blue in their absence.

Simple Hardness Test Set

(Employing Sodium Versenate Titration)

The titrating agent in the new method is a standardized solution of sodium versenate—the full name of which is dé-sodium ethylene diamine tetra acetate. This reagent reacts with calcium and magnesium to form complex ions rendering the calcium and magnesium inactive, yet no precipitate forms, the solution remaining clear. The end point is detected by the use of an indicator which changes sharply from red to blue when the last of the calcium and magnesium is tied up, or sequestered, by the hardness reagent.

To make a determination of total hardness by the new method, a 50ml sample of water being analyzed is placed in a 250ml flask with 2-4 drops of the hardness indicator solution and 1 ml of a concentrated buffer solution to hold the pH around 10. The color of the mixture will be red. Standard hardness reagent is then run in from a burette until the color changes from red to blue, the actual end point being the disappearance of the last trace of red. The volume of standard hardness reagent required to cause this change is multiplied by 20 to give the total hardness in parts per million of $CaCO_3$.

The sensitivity with this procedure is about 2 parts per million. Hardness has been determined in waters up to 1400 parts per million without dilution. By modifying the procedure somewhat, using a larger sample with more indicators and buffer and a burette with smaller graduations, accurate results can be secured at very low hardness values such as are encountered in exchange-softener effluents.

Experience with this new method to date indicates that it is superior to the soap method in accuracy, speed and convenience.

Ed. Note: "The Versenate Titration for Total Hardness" has been published in detail in the January 1950 Journal of A. W.W.A. since the receipt of this condensed description of the method developed at the Univ. of Zurich, Switzerland.

*Research chemist, W. A. Taylor & Co.

A CREEPING DROUGHT UNDER WAY

A Study of Relationships Between Recent, Current and Prospective Droughts

by

HALBERT P. GILLETTE

(Mem. Am. Soc. C.E.)

IN *Water and Sewage Works* for March, 1949, an article of mine gave data showing that for at least 90 years the Nisqually Glacier in Washington has been shrinking, and for at least 80 years the annual runoff of the Columbia River has decreased. It was shown that varved rock strata indicate a climatic cycle of about 600 years, with a subcycle of ⅓ that length—namely, 200 years. The accompanying photograph shows those two cycles, the white chalky calcareous beds recording the dry phases of those two cycles. By means of lake varves (annual layers of sediment), tree-rings, annual extremes of elevation of the Nile back to A.D. 620, and other data, it has been found that coincident rainfall peaks of the 603 year, the 201-year and 67-year cycles occurred in A.D. 1683. Hence they will have coincident rainfall minima in 1984.

Evidence as to the above mentioned cycles was presented by the writer eight years ago in a paper entitled "Menacing Long Series of Droughts," read before the National Reclamation Association at its annual meeting in October 1941, and printed in the December 1941 issue of *Water Works and Sewerage* (now *Water and Sewage Works*), and in the February 1942 issue of the *Pan-American Geologist*. Since then the writer's researches on climatic cycles and weather have added to the evidence then presented.

Recently the *London Sunday Express* quoted Dr. C. E. P. Brooks, Secretary of the Royal Meteorological Society, as follows: "The earth's climate has been changing since about 1850. The process is speeding up, but it is still too early to say if the change is to be of long duration, say of thousands of years, or if we are to have a temporary change lasting, say a century. We shall know better in the next 25 years whether we are going back to the [dry-warm] climate of between 400 and 1000 A.D."

Dr. Brooks based his conclusions on what is happening in the Arctic, pointing out that the fish are moving farther north each year because it is becoming warmer there. In addition, Dr. Brooks observes that the "cultivation of crops and the raising of animals is just beginning to be possible again in parts of Greenland."

In his "Climatic Changes," the late Dr. Ellsworth Huntington of Yale gave a graph of his measurements of California sequoia rings which shows a long drought having its climax about A.D. 740. Since this is about 900 years prior to the great advances of European glaciers, I infer that there is a climatic cycle of about 1800 years or three times the length of my 600-year cycle. Intervals between the greatest moraines in the last Ice Age were about 1800 years, as shown by varves deposited annually in ancient glacial lakes that are now dry. Lesser moraines recorded the 600 and the 200 year cycles.

Annual maximum and minimum levels of the Nile at Cairo since A.D. 620 record the 200-year cycle and cycles of ⅓ and 1/9 its length, and show the dry maximum of the 1800-year cycle about A.D. 780. The subsequent long trend of increasing levels of the Nile has often been ascribed to silting up of the river bed. But the writer infers that the cause was the 1800-year cycle. There is no evidence of silting of the bed between the earliest record A.D. 620 and 780, for the annual levels of the river decreased during those years.

A Creeping Drought Underway

In "Quarternary Climates" (pub. in 1925 by Carnegie Institution, Washington, D.C.), Prof. J. Claude Jones estimated that Walker Lake, in Nevada, had acquired its chloride content from salt delivered by Walker River in about 1160 years. He inferred that the lake went dry and its bed was silted over before it began to fill again. This indicates that it was dry about A.D. 760, which agrees closely with the time of lowest levels of the Nile above cited. An article by C. E. P. Brooks in *The Meteorological Magazine* (London), July 1935, gives four graphs of thicknesses of Lake Saki (Crimea) varves, California sequoia rings, and approximate levels of the Caspian Sea and of European lakes. The last two graphs indicate a maximum drought about A.D. 740, as compared with about A.D. 760 for Walker Lake and A.D. 780 for the Nile. It is significant that the Dark Ages in Europe and the many years of "political chaos" of an earlier time in China had their center about A.D. 780 also. Since there is good evidence that this catastrophe was due to the 1800-year cycle (and probably the 5400-year cycle also), it will not occur again for several hundred years. But since the 600 and the 200-year cycles are harmonic subcycles of the 1800-year cycle, we are now in the midst of a *creeping drought* whose maximum is only about two decades ahead.

Because there are many short weather cycles, the progress toward such a climax has not been, and will not be uniform. The "dust bowl" years of the middle 1930s were largely due to the Bruckner Cycle whose length is half that of the 67-year cycle above mentioned. Its next wet peak will be due in the summer of 1950.

The 8.44-month cycle will have its wet peak January 18, 1950; it is a subcycle of the 19-year cycle whose last wet peak was in July 1946. These shorter cycles are mentioned to exemplify the complexity of long range weather forecast problems, which is rendered additionally complex by other factors, notably opposite effects in different regions due to "permanent" cyclonic control in some regions, and anticyclonic control in other regions, as pointed out in the September 1949 issue of *Water and Sewage Works*.

One of the factors that adds complexity is that the same cycle may cause fall and winter rainfall to be opposed in phase to that of spring and summer. This was pointed out in one of my articles several years ago. It tends to obscure the existence of short cycles when the analysis relates to annual rainfall in regions having about the same rainfall in each of the four seasons.

Short Cycles of Secondary Concern

Engineers concerned with water supply problems need not worry about the short weather cycles; but should carefully study the evidence of long climatic cycles. Fortunately those of greatest importance are few in number and are harmonic. The dominant harmonic series is triplex, and has lengths in years of 67, 201, 603, 1809, 5427, etc. These are very outstanding in geological records, such as

are to be found in the series of similar beds of rock, raised beaches around lakes, sea-shore terraces, and intervals between successive glacial moraines. But unfortunately meteorologists have not investigated geological data enough to be convinced that these cycles are regular as to their lengths, harmonic as to their relationship, and greater in amplitude (departures from a mean), the longer the cycle. The dry and wet phases of these climatic cycles increase as the length of the complete cycle increases —i.e., the period between maxima.

As Bruckner pointed out in his book in 1890, his climatic cycle has alternating wet-cold and dry-warm phases. He estimated its length between centers of similar phases to be about 35 years. But his data covered too short a period to give more than an approximate length. Lake Saki varves going back 4200 years and California treerings for 3200 years show a cycle that is exactly 67 years, which often has an intermediate peak causing a lesser cycle of 33.5 years. One of the cold-wet peaks of the Bruckner and the 67-year cycle occurred in July 1816, which in New England was so extreme that 1816 was called "the summerless year". This extreme was partly due to the 19-year cycle whose peak was in the summer of 1813, and which has a 3 1/6-year subcycle whose peak was in 1816.

Varved Rock Strata Show Climatic Cycles of 200 and 600 Years Between Centers of Droughts

Sedimentary Deposits Offer Best Evidence of Long Weather Cycles

Recent progress in cycle research has been due largely to a very old discovery, namely that distinct layers of sediment have been deposited annually in lakes and in seas. These layers are called varves. That they were annual depositions was surmised in 1769 by C. F. Nordenskiold, a Swedish military engineer. Swedish geologists were the first to measure thicknesses of many varves, but they erred in thinking that varves occurred only in glacial lake beds. The writer has measured varves in stratified rocks of marine origin in a dozen of our states and in Mexico. Since cyclic variations in the thickness of rock varves correspond with those in treerings, there can be no longer any question as to their having been deposited annually.

The white calcareous beds of the accompanying photograph were deposited during the warm phases of cycles, because evaporation and less of carbon dioxide from seawater or lakewater caused precipitation of chalky calcium carbonate. Rock varves one-tenth of an inch thick sometimes have a white calcareous lamina that records the precipitating effect of the summer's heat.

Aided by this knowledge, pairs of white and black beds in stratified rock become data by which the lengths of climatic cycles are determinable. And, since the drainage areas whence these sediments came were very large, stratified rock data are far more reliable than any other data for determining the lengths of long climatic cycles.

Inscriptions in three languages on the famous Rosetta Stone were found 150 years ago, and served to disclose the meaning of Egyptian hieroglyphs, while series of similar rock beds, evenly spaced, constitute natural hieroglyphic records of climatic cycles, and varves therein are Nature's "Rosetta Stones" that disclose the cycle lengths.

N. Y. Section A.W.W.A. Mid-Winter Lunch

Holding its annual mid-winter luncheon during the week of the A.S.C.E. meeting in January in New York City, the N.Y. Section of A.W.W.A. was host to the members of the A.W.W.A. Board of Directors which was also holding its annual meeting that week in New York.

More than three hundred fifty persons attended the luncheon and heard a short talk by Dr. A. P. Black, Pres. of the A.W.W.A. as well as talks by Prof. Leo. Wolman, Prof. of Economics at Columbia University and by E. J. Clark, Chief Engr. of the New York City Dept. of Water Gas and Electricity.

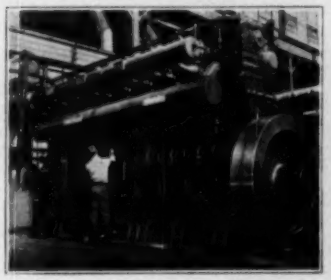
Prof. Wolman spoke interestingly and humorously on national budgets and Mr. Clark explained the reasons for the water shortage in New York City and the plans to remedy the situation.

Columbus Sewage Plant Installs Dual-Fuel Engine

The City of Columbus, Ohio is installing a new 1440 hp. dual-fuel gas engine at its sewage treatment works. The new engine, an 8 cylinder, 14½ x 20 supercharged Superior Engine manufactured by the National Supply Co. will be operated in parallel with a power supply from the municipal light plant and the existing gas engine generators at plant.

The new engine is of the vertical four-cycle type and will operate on any mixture of sewage gas and diesel oil ranging from 10 to 100 per cent of oil. Natural gas may be used in lieu of sewage gas.

The installation of this unit will increase the power generating facilities of the plant, decrease its dependence on municipal power and at the same time utilize sludge digestion gas formerly going to waste.



NEW YORK'S DELAWARE WATER SUPPLY BEING PUSHED AHEAD

Provision Made for 100 M.G.D. Emergency Supply from Hudson River

IN order to provide its 8 million citizens with a dependable supply of water, and to service industries, utilities and air conditioning installations, whose tremendous water requirements hoist the average per capita consumption to 140 gallons per day, New York City is in the process of spending $500,000,000 or more in a tremendous water supply program. Known as the Delaware Water Supply, the development is designed to pipe something more than half a billion additional gallons of water per day into city distribution mains from tributaries of the Delaware and Hudson Rivers.

Until the recent water saving appeals by water supply authorities, the city has been using about 1,200,000,000 g.p.d., with summer peaks reaching 1,500,000,000. Consolidated Edison Co. of New York, Inc., and its subsidiary, New York Steam Corp., which uses nearly 5 billion gallons per year in the development of power and steam for the city's dwellings, is the largest water user. The second largest user is believed to be the Brooklyn Navy Yard. Collectively the more than two dozen breweries likely represent the third largest water using industry.

The increasing use of air conditioning apparatus has constituted another burdensome factor of unknown proportions, tending to drain New York's water supply to the limit. A constantly increasing demand for water indicates that the total figure will approximate 2 billion g.p.d. by 1960.

New York began to actively attack the problem of increasing its water supply back in 1936, when the tremendous Delaware program got underway after bogging down under the economic depression and a drawn-out legal battle over water takings from the interstate Delaware River.

Today, 75% complete, the project has yet to see six to seven more years of activity, according to present estimates, before completion. Already in operation are an 85-mile-long tunnel aqueduct, driven its entire length through solid rock, and a $30,000,000 dam and reservoir. A second dam is well on the way to completion, with a third getting underway. Also under construction is a $750,000 municipal sewer system, including a disposal plant, which New York is bestowing upon the city of Grahamsville, N. Y., in order to prevent contamination of one of the three new sources of supply.

What Comprises the New Delaware Project

Briefly, the Delaware Water Supply Project consists of the Downsville Dam, backing up the Delaware River into Repacton Reservoir; Neversink Dam, backing up the Neversink River into Neversink River Reservoir; Merriman Dam, backing up Rondout Creek into Rondout Reservoir; a 6-mile tunnel connecting Neversink and Rondout Reservoirs; a 26-mile tunnel connecting Repacton (East Branch) and

Core Wall of Neversink 280 ft. High Earth Dam

Earth moving equipment includes 180 Euclids of 9.5 to 24 cu. yd. capacities; 14 sheepsfoot 10.5 ton rollers; 25 bulldozers. Three of the sump stacks or wells on the earth compacting drainage system, referred to in this article, are visible along the front of the wall. Equipment on this project is said to have cost $5,000,000.

Rondout Reservoirs; and the unprecedented tunnel aqueduct which stretches for 85 miles from Rondout Reservoir, closest to New York City, connecting the Delaware Water Supply to the existing Croton, Kensico and Hill-View reservoirs. Only recently has been projected the emergency pumping station on the Hudson River near the point where the Delaware Aqueduct passes under the river. At this point up to 100 m.g.d. of super-chlorinated river water will be pumped into the system in an emergency.

Merriman Dam, whose Rondout Reservoir is already pouring water into the aqueduct, originally got underway in 1937 under a $15,486,000 contract awarded to Mason and Hanger Co., Inc. of New York City. In 1941, when work was interrupted by the war, the firm had completed the dam's concrete-core wall, a diversion tunnel for Rondout Creek, about 8,300 feet of the aqueduct tunnel and the shaft connecting the reservoir with the aqueduct.

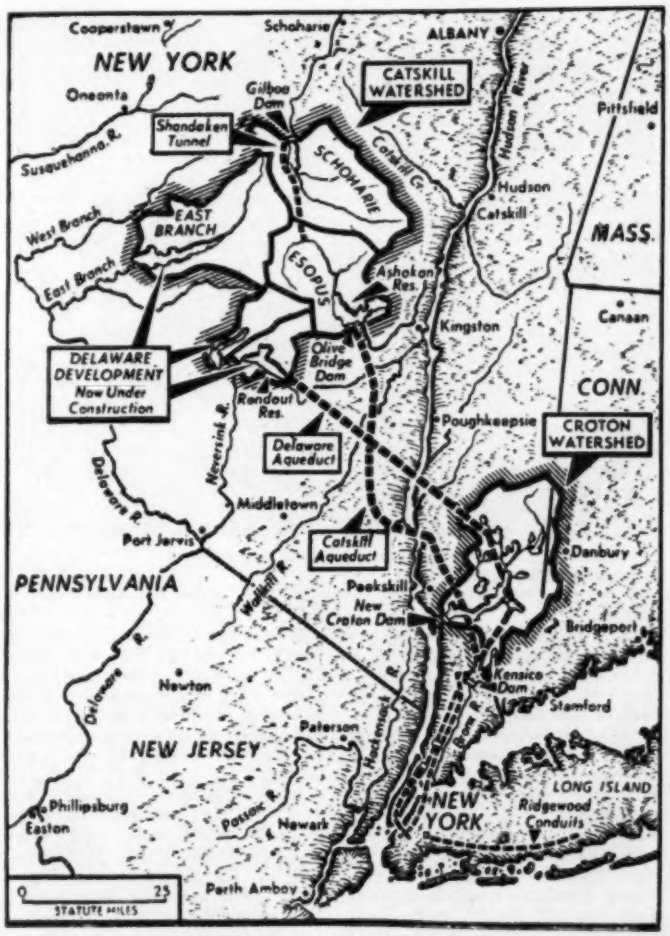
The S. A. Healy Co. took over a new $14,300,800 contract in 1946 for completing the rolled embankment section of the dam and constructing the reservoir intake chamber and other subsidiary projects.

Work on the Downsville Dam (Repacton Reservoir) got underway November, 1947, with Walsh Construction Co. and B. Perini & Sons receiving a contract for the diversion dam, diversion tunnel and cut-off wall. This first phase of the project is approximately half finished, and the entire job is estimated for completion by 1956. No contract for the earth portion of the dam (contract No. 401) has yet been let, bidding is expected to be opened in the near future.

Contract No. 360, for construction of diversion dam, diversion tunnel and exploratory caissons for the Neversink Dam, was let to M. Brewster & Son Co., Bogata, N. J., in 1941. The S. A. Healy Co., completing the project on a $25,000,000 contract, has constructed the cut-off wall and is currently in the process of hauling fill for the earth dam. Work on the Neversink Reservoir is scheduled for completion in 1952.

Construction of Neversink Dam Being Speeded

Conditions of terrain at the Neversink site, and consequently the design and operation, are remarkably similar to the other two dams. The dam is being constructed in a deep, steep-sided valley in which bedrock is overlain by 100 to 180 feet of irregularly deposited sand, gravel, boulders and clay in various combinations.



New York City's Three Major Water Supplies

The stand-by 100 m.g.d. pumping station is to be located on the west bank of the Hudson near the point of crossing of the new Delaware Aqueduct. In an emergency super-chlorinated Hudson River water will be pumped into the aqueduct, but only to the extent of 100 m.g.d. maximum. Interestingly, Poughkeepsie sewage does not seem to reach the west shore of the Hudson, where the water quality is surprisingly good.

The Neversink Dam, like the Merriman and Downsville, is an earth dam with cut-off wall set in bedrock; it will have a valley-side spillway founded on rock, and a diversion tunnel in bedrock around one end of the site will handle stream flow during the period of construction.

Approximately 200 feet high, Neversink Dam measures 2500 feet along the top. It will be 1500 feet thick at the base, 60 feet at the top. It will ultimately require approximate 8 million cubic yards of rock and compacted soil for its earth wall, 1 million cubic yards of which will be rock laid in a layer over compacted earth.

In laying the wall foundation, a deep angular trench was cut to a depth of 150 feet in order to reach the underlying bedrock. A trench was then cut in the bedrock itself, with the base of the wall resting on the rock. Screened earth, with rocks larger than 5" diameter removed, was dumped in the trench and packed with tractor-drawn sheepsfoot rollers.

Construction Drainage System Important

In order to maintain dry soil during backfilling, a system of vitrified clay pipe underdrains was devised to augment a Moretrench well-pointing system.

These drainage installations consisted of 7,500 feet of vitrified clay

Sewage Treatment Plant and Sewer System
Under construction by the Board of Water Supply of N.Y. City, at cost of $750,000, to purify the sewage of Grahamsville on the Neversink watershed.

pipe, in 12" and 6" sizes. Each side of the earth wall was served by an independent system. Main lines of 12" clay pipe were laid parallel to the base of the dam, with 12" and 6" laterals laid with open joints in several inches of coarse gravel on the sloping sides of the trenches. The 6" laterals also extended from the main line, at right angles, to the base of the wall. The 12" clay pipe mains fed into vertical shafts of corrugated steel pipe, three shafts spaced at regular intervals on each side of the wall. (See picture.) Height of the shafts was kept equal to the level of the fill as work progressed, a pump connected to each vertical stand pipe removing water as it accumulated.

When the trench had been filled to the depth of the valley floor, pumps were disconnected and the drainage lines were filled with grout.

The completed Neversink Reservoir will constitute a lake some 5 miles in length and one-half mile wide. Situated in a region experiencing high annual mean precipitation (40 to upwards of 60 inches) the dams will collectively receive enough run-off to capture 540,000,000 gallons of water per day.

Healy has some 500 men and $5,000,000 in equipment employed on the Neversink project, earth, moving conveyances including (approximately): 180 bottom dump and back dump Euclids, ranging from 9½ to 24 cubic yard capacities; 14 sheepsfoot 10½-ton rollers; 25 bulldozers, with smooth rollers, power shovels, drag lines and other excavating and hauling equipment.

New Sewer System and Treatment Plant Necessitated

Construction of the Neversink Reservoir entailed a problem in stream pollution correction which is being solved by installation of a complete sewerage system and treatment plant for the town of Grahamsville, at a cost of $750,000 to the New York City Board of Water Supply.

Grahamsville's new sewage disposal plant is of the trickling filter type, containing four filter beds each measuring 90′ x 150′ and with a total capacity of 80,000 gallons per day. DiMarco and Siccony of White Plains, N. Y., were the contractors on the sewer system disposal plant.

Simpltaneous with construction of the earth dam itself, work is proceeding on the 6-mile-long tunnel which will connect the Neversink and Rondout Reservoirs. Scheduled for completion in two years, the tunnel is being driven under a $15,000,000 contract awarded to Frazier-Davis Construction Co.

117 Miles of Pressure Tunnel

Including the Neversink-to-Rondout and the Downsville-to-Rondout tunnels, total tunnel length for the Delaware Water Supply is 117 miles. The pressure tunnel aqueduct proper begins at Rondout Reservoir, control point for all water flowing into the aqueduct, connecting with City Tunnel No. 2 (put into service in 1936) at Hill View Reservior 85 miles distant.

Tunnel diameter varies from 10 feet to 19½ feet, concrete lined. Starting at an elevation of 1250 feet its greatest depth is 2500 feet below ground level as it passes under the Shawangunk Mountain Range, dipping to 660 feet below sea level in a by-pass tunnel at the Kensico Reservoir.

Thirteen permanent shafts will provide access to the pressure tunnel. Fifteen other shafts, for construction only, have been sealed top and bottom.

At a total cost of $140,000,000 ten contractors worked the eleven contract sections into which tunnel construction was divided.

Wisconsin Fills Two Important Positions

Muegge Becomes State Sanitary Engr. and Wisniewski Director of Stream Pollution Control

Within recent weeks, the State of Wisconsin has made two very important appointments. To succeed L. F. Waring who resigned as State Sanitary Engineer to become head of the Research Section of the Stream Pollution Control Div. of the U.S.P.H.S., Wisconsin has appointed O. J. Muegge. A graduate of the Univ. of

O. J. Muegge

T. F. Wisniewski

Wisconsin, Mr. Muegge has been with the Wisconsin State Board of Health since 1923, except for the year he spent at Harvard obtaining a Master's Degree in Sanitary Engineering.

Also recently, T. F. (Ted) Wisniewski was appointed as Director of the Wisconsin Stream Pollution Committee. This position had been created by law a few months before with the establishment of the Stream Pollution Committee to relieve some of the work on the State Sanitary Engineer. Mr. Muegge has been an engineer on the State Dept. of Health for a number of years and is well known for his work on industrial wastes, particularly in the milk industry.

WATER TREATING EXPERIENCES

Handling the Medium Soft Poteau River Water at Fort Smith, Ark.

The Second of a Series of Articles

by

A. H. ULLRICH,

Superintendent Water and Sewage Treatment
AUSTIN, TEXAS

WHEN the author assumed charge of the Fort Smith, Arkansas, plant in 1927 the treatment consisted of coagulation with alum and lime, settling, filtration and post chlorination. The treatment methods probably differed but little from those used at other plants which treated a similar type of water. Coagulation at an optimum pH and pH adjustment for corrosion control were not yet practiced at many of the smaller plants. By present standards the alum and lime dosing could be considered somewhat haphazard. The idea was to get a good floc which would settle well and give a clear filter effluent. The operators knew that about one-third as much hydrated lime, by weight, as alum was required to keep the water in approximate balance as to alkalinity, but further than that it was merely a question of adding alum and lime until an acceptable floc was obtained. At that, the experienced and conscientious operators did a remarkably good job.

Since the plant did not have pH testing equipment in 1927 we started pH control, after a fashion, by using phenolphthalein as the indicator. If we had a change in raw water turbidity the alum dosage would be increased or decreased with the turbidity and the lime dosage would be adjusted quickly so as to give a faint pink color with phenolphthalein in the mixed water. Then the lime dosage would be reduced by small increments until the pink color just disappeared. The phenolphthalein test was thus used for quick control but it was still checked with the methyl orange titration for total alkalinity of the raw and filtered water.

That our operators became quite adept in the use of phenolphthalein test and the total alkalinity test was shown in 1931 when we finally purchased pH testing equipment. It was then found that they usually hit in the pH range of 7.2 to 7.6, which was very near the optimum coagulation range for Poteau River water. The point which we missed, however, was that the optimum pH varied both when the Poteau water had exceedingly low alkalinities and when it had high alkalinities due to admixture with

The Author

Arkansas River backwater, as related in the previous installment. Another point which we missed was that the buffering ability of the water varied from periods of low alkalinity Poteau water to high alkalinities of Arkansas River backwater. We did notice that at times the water seemed to require higher alum dosages than those related to total turbidity alone. This was attributed to a difference in the character of the turbidity and to the fact that the plant did not have a slow mix mixing chamber or flocculator for proper floc preparation. It was later realized that while the character of the turbidity may have affected the required alum dosage it is likely that changes in the buffering capacity of the water, together with changes in the optimum coagulation pH range, may have been of major importance. Later experiences in supervising treatment of the Grand River water at Muskogee, Oklahoma, which had alkalinities consistently in excess of 50 ppm (and with Lake Fort Smith water, the alkalinity of which was normally less than 20 ppm) impressed the author with the importance of the total alkalinity as a buffering agent. It was consistently easier to obtain good coagulation with the Muskogee water than it was with the Lake Fort Smith water, even though more rigid pH control was practiced at the Lake Fort Smith plant.

As previously noted, no serious attempt was made at pH adjustment for corrosion control in treating the Poteau River water. After the purchase of the pH testing equipment in 1931 we did make certain that the treated water always had a pH above 7.0 and normally tried for a pH from 7.2 to 7.6. With this type of water (first article of this series gives detailed analysis) we received few red water complaints, few corrosion complaints and very few complaints regarding hot water heaters. Red water complaints were, in general, satisfied by main flushing in the vicinity of the complaint while the few corrosion complaints were attributed to the use of poor quality pipe. The few hot water heater complaints were usually due to clogging of instantaneous coil type heaters by encrustation, rather than to corrosion. Since the water as treated was not unduly corrosive, no corrosion studies were made on it. Later, however, it became the author's opinion that the relative non-aggressiveness of the water was probably due to the fact that it contained silica and carried bicarbonate hardness in excess of 40 ppm for extended periods. At any rate, it seems likely that the average bicarbonate hardness was sufficient to cause protective scale formation in galvanized hot water tanks.

Having heard Mr. Ullrich speak on various occasions, the editors realized that he is well qualified to present to the readers of *Water and Sewage Works* a series of articles discussing some of his varied experiences in treating waters of vastly different characteristics. This is the second article of a series.

In addition to his qualifications as a first rate operator of water treatment plants, Mr. Ullrich has done a good job of advancing good relations between the water utility and the public. In this article is a sample of practicing the Golden Rule which can always be calculated to advance public relations. We have printed speeches made by Mr. Ullrich before civic clubs which "rang the bell" so to speak, and we hope that a sample of some of his "plain talks" on the local water supply will appear later on in this series.

Raw Water Chloramination

As mentioned earlier, the standard disinfection or sterilization treatment used in 1927 was post-chlorination. While some prechlorination was practiced later, from time to time, post-chlorination was continued as standard practice until November, 1932. During that month a local cloudburst

washed out an earthen dam which impounded large quantities of waste wash water and the highly putrescible filter cake washings of the then world's largest sorghum syrup plant which was located on a small tributary of the Poteau River. The flow in the river and in the tributary was such as to cause the waste to flow to and surround the plant intake and to remain there for several days. The chlorine demand of the water became very high—just how high we do not know. We do know that our three 100 pound chlorine machines feeding their full capacity into the suction end of a 6.0 M.G.D. raw water pump failed to give even a trace of chlorine residual in samples taken directly from the pump discharge. Fortunately we had several days supply of filtered water in our storage reservoirs so the plant was shut down until we could obtain and install an ammonia machine. Within forty-eight hours after the waste first reached our intake we had an ammoniator installed and were feeding ammonia together with chlorine into our raw water. No doubt the chlorine demand had decreased in the meantime but at any rate we were able to maintain a satisfactory chloramine residual without difficulty and were obtaining a safe water on and through our filters.

Pretreatment of the high chlorine demand water which was obtained during the sorghum plant waste period worked so well that the same treatment was continued until the Poteau Plant was abandoned in 1936. By treating the raw water with chlorine and ammonia (we used four pounds of chlorine to one pound of anhydrous ammonia) we were always able to maintain the desired residual all the way through the settling basin, the filters and the clear well. This method of treatment provided a supply of safe water in the settling basin and in the filters so that there was always ample time to detect a chlorine machine failure or stoppage. While it was never necessary to post-chlorinate after we started pretreatment with chloramines we did maintain a standby machine for post-chlorination. Since this early experience in pretreatment, the author has been convinced that the added factor of safety and the resulting feeling of security which prechlorination gives is well worth any increase in chlorine usage which it may cause.

"Public Relations at Work"

As noted in the first article of this series, the Poteau River Plant frequently received Arkansas River backwater, which contained high salt concentrations and usually had an objectionable woody taste. There was, of course, nothing that we could do about the high salt content, and we soon learned that there was little we could do about the woody taste. Neither the use of activated carbon nor any combination of chlorine treatment did much to improve the taste which seemed, somehow, to be fixed in the water and was apparently related to the saline taste. In addition to the objectionable taste, the high salt content and increased hardness during these periods also made the water poor in quality for industrial use. Ice plants and soft drink bottling plants were probably the most adversely affected, but the domestic consumers certainly also had just cause for their many complaints at such times.

Since we could not improve the taste of the Arkansas River backwater, but could only clarify it and disinfect it for safety, we soon learned that the best way to answer complaints was to admit the presence of the bad taste, to explain the reason for it and to assure the public that the water was at least safe. Answering these complaints was always a chore and, of course, time consuming and the public did not always seem too well satisfied. Finally it occurred to the author that if we could predict Arkansas River backwater twenty-four hours to several days in advance and would advise the public through the newspapers that they could expect "salty" water within a certain time period we could not only "sell" ourselves but would stop many of the complaints.

By working closely with the local weather bureau and obtaining their early predictions of the river stages we were able to make almost equally accurate predictions as to backwater and anticipated complaints. The first of these predictions was given by telephone to all local ice plants to permit them, if they had the facilities, to make and store ice for the expected salt water period. Our prediction was far enough in advance to be of actual help to these plants and the manager of the largest ice plant was so impressed that he wrote the Water Commissioner, praising him for having an employee who had the interest of his customers at heart. The letter went on to state that it was the first time in his experience that a municipal employee indicated a genuine desire to be of service to the public. The favorable response to the first prediction led us to list all industries which wished to be called as soon as we were reasonably certain that we would be required to treat and pump Arkansas River backwater. The same information was also given to the newspapers so that the public expected the salty and bad tasting water before it reached them.

Since these early experiences the author has found that if he had prior notice that an unpleasant condition or situation would shortly come to pass, advising the public of all details as soon as possible helped maintain, and even improve, friendly relations.

Likewise, it has also been his opinion that a water works man should be a constant student of the quality of his product so as to be thoroughly familiar, both with its good points and its faults. Then he should be frank and honest in his talks before Civic Clubs and other interested groups. Only in this way can he hope to convince the public that they have the "best water in the world" or, if the water isn't so good, sell them on the idea of spending adequate sums of money to provide a new and better source of supply, or provide new facilities to better treat the existing supply. If is our belief that an informed public in Fort Smith made it easy for the City Administration to sell the citizens on voting the bonds for a complete new mountain lake supply, new filter plant and pipe line, the construction of which got under way in 1935. Experiences in treating the soft mountain lake water of the new Lake Fort Smith supply will be the subject of the next article of this series.

Ohio Exams for Operator Certification Set for Apr. 28

The Ohio State Dept. of Health will hold examinations for the certification of water and sewage plant personnel at central points throughout the state on April 28, 1950. The examinations are to be given applicants for Grade "A," "B" and "C" certification in Columbus, Cleveland, Cincinnati, Toledo and Massilon.

If any water or sewage plant operator or manager desires to qualify for these examinations (no matter what his present residence may be) it is only necessary to request application blank, fill it out and return to the address given below. The applicant will be notified of his acceptance as an applicant for the grade of certification for which he can qualify well in advance of the examination date, and will be told where and what hour to report on April 28th for examination.

Applications should be made before March 18th to G. A. Hall, Sec'y. Advisory Board of Examiners, c/o Ohio Dept. of Health, Columbus 15, Ohio.

OPERATION OF SMALL WATER PLANTS

The Distribution System

by

A. E. CLARK

General Manager

NASHVILLE SUBURBAN UTILITY DISTRICT

NASHVILLE, TENNESSEE

THE distribution system receives the water conveyed to it by the supply mains and delivers it over the area of the community served in accordance with the needs of the various sections, with its fire hydrants, valves and other accessories, reservoirs and standpipes. The purpose of the distribution system is to distribute water at a relatively uniform pressure. Depending on the topography of the area served, there are quite large variations in pressure in some cities while in others where the land is relatively flat the pressures are quite uniform.

Design

The design of a distribution system requires considerable thought and study as well as a knowledge of engineering. Provision for fire protection requires a different layout than a strictly domestic supply. An unsewered community does not require the quantity of water that is needed in a sewered area; however, it is always well to provide mains of sufficient size so that in the event sewers are installed, the distribution system will be adequate.

Insofar as possible and practicable, the design of a distribution system provides for the future needs of a city as well as for the present. Population studies and future trends are studied by the engineer before he attempts to layout the system. Due consideration is given to future industrial development as well as the direction in which expansion of home building will take place. It is much more economical to install feeder mains when the system is installed originally than to have to reinforce some at a later date. Unusual conditions arise forcing changes in the distribution system which were unforeseen when the original installation was made. These are to be expected and there is not any economical manner in which such conditions can be taken care of except when they arise. There are usually some dead end mains, but insofar as possible these should be eliminated when practicable because they are a source of trouble. There should be a hydrant or blow-off available so that each dead end can be blown off if and when necessary.

Pipe and Pipe Joint

The pipe in most general use is cast iron, although steel, "Transite" and concrete pipe are used. Depending on the type of water, cast iron pipe is used either with the coating as put on by the manufacturer, or is cement-lined to prevent corrosion. Jointing is usually the bell and spigot; however, there is a great deal of mechanical joint pipe also used. Either type of joint, properly made, is entirely satisfactory. When bell and spigot joints are made the jointing material can be either lead, sulfur compound, or cement, all of which make good joints. Sulfur compounds may have an advantage over lead in that the poured joints do not require caulking, thus saving on labor. Cement joints are effective, relatively cheap and quite satisfactory.

There are joints under certain conditions that are supposed to be more satisfactory if poured with lead. This is a matter of opinion. Whichever jointing material is used or if mechanical joints are used, every joint should be inspected under the specified pressure for leaks or defects. Any leak or defect should be corrected before the trench is backfilled. When lead jointing material is used, recaulking usually corrects a leak. In the case of sulfur cement if the leak is too large to take up, the jointing material must all be removed from the leaking joint and repoured.

Gate Valves

The number and location of gate valves on any distribution system is most important. For a new system, first decide on the gate valve or valves to be used, and adopt a policy of the direction in which they will open. This policy should then be followed in all future installations of gate valves. Many instances are on record where gate valves opening in opposite directions have been installed in the same system. This leads to the confusion of finding out which way it opens or, not finding out and twisting off the stem.

Location of gate valves should be studied so that in the event of a break or shut down for other reasons a relatively small area will be without water. A valve box and cover should be installed on all valves and a record made of the valve location on the plat of the system. Definite measurements should be made and recorded so that in the event a box is covered it can be easily located. The number of turns required to close the valve should also be recorded. Some water departments keep an individual card record of each gate valve giving all pertinent information regarding each valve.

After a valve is installed and opened or closed as the case may be, it should not be forgotten as so many of them are, with the first contact with a valve when there is a break. Sometimes they don't operate so well after having had no attention for years after being installed.

Periodic checks should be made of all valves to see that they operate properly, valve box cleaned out if necessary, packing checked and box adjusted if found above or below grade. If there is a leak around the valve stem, take up on the gland or repack, whichever is necessary. If a valve does not close tightly the first time, back off on the stem and try it again.

Sometimes foreign matter will lodge in the seat and working the stem up and down might dislodge it. As an example of this problem, some concrete work was done inside a reservoir under the writer's supervision, and during this period the 12 in. drain valve was open. After the work was completed everything was supposed to have been checked. The drain valve was closed and the reservoir started to fill but there was considerable leakage through the drain line. Instructions were given to shut off the inlet valve and open the drain valve. Inspection showed that concrete had lodged in the seat of the drain valve and had to be chiseled out.

Extreme care should be used on all construction work to see that conditions such as the above do not oc-

cur or any other condition which might cause trouble in operation of valves, such as toe sacks and wood. Pieces of jute left in mains can cause trouble by lodging in a meter service and cutting the water almost completely off. Every length of pipe before being laid should be brushed out to remove any debris or dirt and provision made for sterilizing, either by the use of main sterilizing equipment or the use of a chlorine compound. Sterilizing should be done in accordance with the rules of the local or State Board of Health.

Hydrants

If fire protection is provided the hydrants are placed in accordance with insurance requirements. A valve should always be installed in the line to the hydrant. There are numerous examples where valves were not used and a hydrant broken, making it necessary to shut down relatively large areas during the time required to repair it. Many times, too, large quantities of water are wasted due to the lack of a valve. Hydrants like gate valves must be maintained if they are to operate properly. In case of a fire, a non-operating hydrant is useless and may be the cause of large fire damage. When a hydrant is installed provision should be made for drainage around the hydrant. In practice about ½ cu. yd. of stone is placed under and around the hydrant to provide drainage. Hydrants should be checked not less often than once every six months, checking for operation, leaks and packing.

Under ordinary conditions no one should be allowed to operate hydrants but the water department and fire department personnel. It is a good idea to have the members of the fire department report any trouble that might be experienced in operating a hydrant so that it can be repaired immediately. A card file should be kept showing the location, type, size, make, size main to which connected, and size and make of valve. Hydrants can be numbered using metal tags secured under a bolt head. This is done in a great many cities.

Maintenance

Proper maintenance is the key to success in the operation of any water system. Maintenance requires sufficient equipment and supplies on hand at all times. Transportation equipment is most important. The type and number of vehicles depends on the size and extent of the system. In case of a main break, equipment of sufficient size should be available to transport all needed pipe and supplies to repair it.

Spare pipe of all sizes in the distribution system should be kept in stock as well as a certain number of specials. The amount depends on whether a water department makes extensions, etc., or just makes repairs when necessary and contracts all other work. It is well to have spare valves in stock of the size used in the system. Packing of the size and type for different size joints and jointing material used as well as the jointing material should always be in stock.

Split and solid sleeves for all sizes of pipe used should be on hand. When split sleeves are purchased it is a good idea to specify lead gaskets. An employee works much more efficiently if he is furnished with the proper tools with which to do his work. Wrenches of the various types and sizes should be available to the workers. In the case of a main break at night, lighting is most important. Small, compact lighting outfits are on the market and all well equipped water departments need them. Some departments use flood lights while others string up lights, the main idea being to furnish sufficient light for the workers when needed.

A great deal could be written regarding the equipment and tools that should be carried by a water department, but most of it is standard and handled by a number of concerns. Some thought should be given to the purchase of equipment and tools. Those things which are necessary should be bought, while, on the other hand, a great deal of material can be purchased which will lie idle for long periods of time. It requires some judgment as to the number or amount of items to be carried in stock and this is based on past usage.

Sometimes the proper location of a main is not shown on the plat and in some departments there are quite a number of mains and stubs not shown at all. If it becomes necessary to locate or excavate at a main not located, for any reason, considerable time and expense might be involved in locating the main. The use of a main locator for this purpose will save both time and money. It can also be used to trace out dead ends, service lines, valve boxes, etc.

Unaccounted-for Water

Unaccounted-for water can be a large and expensive item in the operation of a water system. A well operated and maintained system can reduce unaccounted-for water to 10 per cent or less while in some systems it may reach 25 per cent or more. In the latter cases something should be done about it. Every effort should be made to locate the points of loss and correct them. It is necessary many times to resort to a survey of the system by a company specializing in this work. The results of these surveys and correction of the causes for loss of water have paid for the survey many times over. It is assumed that master meters are installed or should be installed in all water works, because without some means of measuring the water pumped or flowing by gravity into the system there is little chance to check unaccounted-for losses. Knowing the quantity of water put into the system and checking the total of domestic and industrial meters for the same period of time it is a simple matter to figure the unaccounted-for water. A leak detector of some type should be a part of the necessary equipment and it should be used not only when a leak is suspicioned but periodic checks of the system should be made. All unaccounted-for water is a direct expense and during these times it is necessary to practice economy consistent with giving the required service.

Elevated Storage

Practically all water systems provide for elevated storage. This is done for two reasons: 1) protection against peak loads; 2) fire protection. Regardless of the purpose, storage reservoirs or tanks require maintenance. In the case of steel standpipes or elevated tanks, painting is needed periodically as well as careful inspection for corrosion and pitting. Cathodic protection devices are on the market to prevent inside corrosion and pitting of steel tanks. Specifications for painting as well as inspection are available through the American Water Works Assn., and it is a good idea to follow these specifications and be sure that proper repairs and painting are done.

Concrete reservoirs require little maintenance, but if a covered reservoir is used the manhole cover should be securely locked, and this applies to standpipes and elevated steel tanks. Water level controlling devices should be checked at regular intervals to insure proper operation.

Other utilities have underground lines and they make repairs and extensions also. An agreement between all of the utilities as well as other city or county departments which might cause damage to water mains, valves, etc., is advantageous, because if work is contemplated in any street the water department will be contacted for location of mains, valves, services, etc., and can be the means of saving considerable work, expense, and trouble.

INDUSTRIAL WATER SUPPLY

by

GEORGE W. REID

Assoc. Prof. of Civ. Engr.
GEORGIA INST. OF TECHNOLOGY
ATLANTA, GA.

WATER is one of the most important raw materials used by industry, and in quantity water is one of the largest raw materials of industry. Therefore it very definitely must be figured into the cost of production. Industries use water for many purposes and requirements as to quality and quantity fluctuate widely. Generally, the uses are classified as follows: Process water, boiler feed water, cooling water, fire protection, sanitary facilities, air conditioning, and a few lesser uses as cleaning, fluming, etc.

Quality is of vital importance in the process water supply and the water must in many cases be treated selectively to meet the specific requirements of a particular product manufactured. Though in most cases domestic water supplies are adequate from the standpoint of quality, quite often additional treatment is required. This is particularly true of small town water supplies.

Where large quantities of water are required and cost considerations make a private water supply advisable, treatment is usually required, especially if it is a limited supply of ground water. For example, Savannah, Ga., has a municipal well supply pumping approximately 13-15 mgd. while one of the city's industries alone, the Union Bag and Paper Co., uses 40-50 mgd. At present, the city's well supplies are being depleted and the city is building 35 mgd. surface water supply system to be developed for industrial purposes. Also, the industrial supply is desirable because the well supplies in that area have 50 to 60 ppm. silica content which is ruinous for boiler waters.

Undesirable Constituents

Table I indicates some of the undesirable constituents of process waters. It will be noted generally, that iron, manganese and hardness interferes with proper dyeing and finishing of silk, wool, and cotton as well as causing similar difficulties in laundering of fabrics. Iron and lime salts also cause trouble in tanning of hides, ice manufacture, beverages, vinegar, glass, films, and paper manufacture.

The Author

Quality Requirements

Biologicals require the highest degree of purification that is necessary in any industry. They must be demineralized and triple distilled so as to be "Pyrogen-free." The pyrogen makes serum and antitoxins dangerous and can be removed by distillation at 464° F.

Ice manufacture and food packing requires that aseptic conditions prevail. Salts cause cloudiness and shattering in ice due to the freezing out effect. Rayon manufacture has developed an ash-free product. This requires complete demineralization of water used. This product was developed during World War II for use in heavy guns. Tubie Rayon (now the Celanese Corp.) mill town at Rome, Ga., treats approximately 8 mgd. of process water.

Beverages have very special water problems. The Coca-Cola Co. maintains mobile laboratories to supervise water quality. For example, one of its problems is that algae in the water will cause the essential oils in the syrup to separate. On the other hand, small amounts of sulfates are desirable in the manufacture of ales and beers.

Water used in the manufacture of concrete is a process water although not ordinarily considered one. Concrete will not set-up if the concentration of sulfates and chlorides is high in the water. One of the most recent contaminents is that of radioactive pollution of water supplies. Obviously, this would be very damaging to a film processor as well as to human consumers.

Quantities of process water vary widely. Table II indicates certain representative flow rates. In Atlanta, Ga., an industrial center, it is estimated that industry used 50 gal./cap./da. and the domestic supply runs 60 gal./cap./da., while Griffin, Ga., a small manufacturing city of 20,000 persons, supplies its mills with 30-40 per cent of its total water out-put. In another case La

Table I

QUALITY OF PROCESS WATER OF REPRESENTATIVE INDUSTRIES

Mfg. Process	Undesirable Constituents	Remarks
Textiles	Color, turbidity, suspended solids, hardness, Mn, and Fe.	Form ppt. in fabric interferes with finishing
Dye Works	Varying pH, hardness, Fe 0.2 ppm.	Poor dyeing, hardness reacts with dyes, causes shades, spots, streaks.
Laundries	Hardness, Fe, Mn.	Costs for soap, ppts. sticks to fabrics causing grayish color.
Paper	Color, Fe, Mn, for fine paper-, not newsprint oils and fats	Oils and fats cause spots.
Biologicals	"pyrogens"	(Perhaps carbohydrates, causing temperature rise in water.)
Ice	Color, suspended solids, Fe 0.2 ppm. bacteria, and bicarbonated 70 ppm. $CaSO_4$ and Mg SO_4 $NaCO_3$ 300 ppm.	Causes cloudiness in the ice. Retards the freezing. Causes shattering.
Canning Foods	Bacteria, hardness and low mineral analysis	Hardness causes toughening of beans and peas.
Tanning and Hides	Fe, lime salts Carbonates	Forms insoluble compounds with tanning CaOH washing with leaves ppt. in the skin
Carbonate Beverages	Fe, Mn, turbidity, color odor, organic matter (Treated water should be balanced) Alkalinity 100 ppm. Hardness 200 ppm. Algae $MgCl_2$	Tends to neutralize flavoring acids Cause essential oils to separate 40 ppm. $MgCO_3$ and $MgSO_4$ desirable
Brewing Ale	pH = 7.0 NaCl 250 ppm.	$CaSO_4$ desirable
Beer	Fe, hardness	
Vinegar	SO^{-}_{4}, Cl^{-}	
Concrete		Are detrimental to setting up.
Glass	Color, suspended solids, a trace of Fe or Mn.	
Photo Films	Color, suspended solids, Fe, Za, Mn, traces of radio active isotopes	Develop deposits exposure

Table II

QUANTITY OF REPRESENTATIVE PROCESS WATERS

Paper		120,000-150,000 gal/ton pulp paper 250,000-300,000 gal/ton high grade
Tannery		8-10 gal/hide/day
Meat (Slaughter House)	cattle	400 gal/animal
	hogs	150 gal/animal
(Packing House)	cattle	2000 gal/animal
	hogs	550 gal/animal
Canning	Corn	38 gal/case No. 2 cans.
	Beans	42 " " " "
	Squash	20 " " " "
	Peaches	93 " " " "
	Pears	92 " " " "
	Apricots	80 " " " "
	Tomatoes	60 " " " "
	Beets	30 " " " "
	Peas	25 " " " "
Milk		100-300 gal/1000 lb. milk
Beet Sugar		100 gal/ton
Brewing		.5 mgd
Textiles	Bleaching	3,000-4,000 gal/100 lb. cotton
	Dyeing	250-2000 gal/100 lb. cotton
Gasoline	(Wash)	60,000 gal/1000

Grange, Ga., treats 3 mgd. and its mills treat separately 2 mgd.

Boiler Feed Water

Boiler feed water has received considerable attention. Most engineers and laymen are familiar with the common effects of boiler scale deposits and the resulting losses of efficiency; fuel is wasted, overheating causes tube failures, and increased shutdowns for cleaning. Whereas boilers formerly operated at 250-450 psi., many are now operating at 1,000 psi., with some up to 2,000 psi. These require a high quality feed water in which there is no silica.

Calcium and magnesium chlorides at the water line may perforate boiler plates; nitrates in the feed water will be reduced by the boiler iron and ammonia will be given off; oil and grease or solids over 2,000-5,000 ppm. will cause foaming; and oxygen will cause corrosion and necessitate deaeration. In addition to these difficulties, the disposition of silica on the blading of steam turbines is creating a real problem in high pressure power plants.

Cooling Water

Cooling water is the largest single industrial use of water. Ground water is of course the most desirable source of water for cooling because of its low and constant temperature. The temperatures of cooling waters, ground and surface, are available through *Heating and Ventilating*, Jan., 1939, or the U. S. Geological Survey. For example, in southeastern U. S., wells in the Piedmont Plateau will have a summer temperature of 63°, in the Coastal Plain 60°, while the surface water will run 80° F. Cooling water should be free of corrosiveness, scale forming minerals, algae, and slime.

Fire protection and sanitary facilities require flows established by the underwriters and sanitary standards established by the health agencies (See Table III). The important factor to be considered is to prevent a cross connection between a domestic supply and an industrial supply. This connection can be direct as in the case of a tie-in for fire protection or indirect in which the two waters are accidentally mixed.

Table III

LIMITS OF CERTAIN CHEMICALS IN DRINKING WATER*

Sust.	Ppm.
Pb	0.1
Fl	1.0
As	0.05
Se	0.05
Cu	3.0
Fe + Mn	0.3
Mg	125.0
Zn	15
Cl^-	250
SO^-_4	250
Phenolic	0.001
Total Solids	500

* Public Health Service Drinking Water Standards. Public Health Reports, Vol. 58, No. 3, Jan. 15, 1943.

Air conditioning uses considerable quantities of water. Table IV indicates the relative requirements in terms of a domestic water supply. Cleaning, fluming, etc., also require large volumes of water. To gage the extent of fluming in the food process industries consider the manufacture of beet sugar. An average plant will use 2,200 gpd. in fluming which is 72 per cent of the total water usage.

To further emphasize the point that water is an extremely important raw product to industry, consider that some very large industries, such as Bethlehem Steel Co. in Baltimore, Md., are now using 50 mgd. of treated sewage effluent because of a water shortage. The industrial use of sewage effluent per se, is new but actually the practice of reusing water as it flows down stream is not. For aesthetic reasons, the direct usage of sewage has been discouraged, but if it is used the public health requirements must be met. Some other examples of water re-use include the Rock Island R.R. at Herington, Kan., where it uses a treated sewage effluent for boiler water; the city of Grand Canyon, Ariz., where water costs $2 per 1000 gal. and treated sewage can be supplied for boilers, lawns, and hydrants for 30c per 1000 gal.; Corpus Christi, and Big Springs, Tex., furnish sewage effluents for oil refineries. Of the some 130 or so different uses of sewage effluents, the use as irrigating water is most popular. Boron and chlorides discharged into sewers sometimes interfere with the use of sewage effluent for this purpose and should be removed at the source.

Treatment

The treatment of water for industry, in addition to generally practised elements of municipal treatment consists of softening and demineralization. Softening is usually accomplished by the lime soda process or by ion exchange or demineralization. The relative costs of treatment are difficult to tabulate, each depending on the amounts to be removed and other impurities in the water.

Table IV

WATER REQUIREMENTS OF AIR CONDITIONING
(Gal. per season)

	Degree of evaporation cooling employed		
	Zero	40%	100%
Office	20,000-30,000	8,300-12,000	930- 1,400
Theatre	4,000- 6,000	1,600- 2,300	180- 280
Dept. Store	11,000-14,000	4,600- 5,900	460- 670
Restaurant	15,000-17,000	6,300- 7,100	700- 790
Drug Store	20,000-23,000	8,300- 9,600	930- 1,040

References

1. Examination of Waters and Water Supplies, Ernest V. Suckling, Churchill, London, England (1944).
2. Industrial Waste Treatment Practice, E. F. Eldridge, McGraw Hill (1942).
3. "Sewage Effluent Reclamation Symposium," SWJ, Vol. 20, No. 1 (January 1948).
4. Heating, Ventilating, and Air Conditioning Guide, ASHVE, New York (1948).

A.S.C.E. SANITARY ENGINEERING DIVISION

Three Sessions Held at New York City Meeting

UNDER the chairmanship of John H. O'Neill, Chief Engr., Louisiana Dept. of Health, the Sanitary Engineering Division of A.S.C.E. held its annual sessions as part of the annual meeting of the Amer. Soc. of Civ. Engrs. The meetings were held at the Hotel Commodore in New York City and a varied program was presented. There were three sessions.

Chairmen

Incoming	Outgoing
A. H. Wieters	*J. H. O'Neill*
Stream Poll. Cont.	*Ch. Engr.*
U.S.P.H.S.	*State H'lth Dept.*
Washington, D.C.	*Baton Rouge, La.*

Sanitary Engineering Opportunities

"THE EXPANDING FIELD OF SANITARY ENGINEERING" by Franklin Thomas, President, Amer. Soc. Civ. Engrs.; Dean of Students and Prof. of Civ. Engr., Calif. Inst. of Tech., Pasadena, Calif.

In opening his discussion of the field of Sanitary Engineering, Dean Thomas reviewed trends as they were set forth in the 1949 report of the A.S.C.E. Committee on the Advancement of Sanitary Engineering. Any discussion of the field must, according to Dean Thomas, define who is a Sanitary Engineer and what constitutes Sanitary Engineering.

The Dean believes that it is too broad to define sanitary engineering as the application of engineering technics to man's environment, and it is too narrow to restrict the definition to "the application of engineering technics to the control of man's health."

A more proper definition according to Dean Thomas is "the application of scientific principles and engineering technics to the problems of water, wastes, insects, rodents and vermin." This would include garbage and atomic wastes but not food and restaurant inspections, milk control and public health.

Among the problems which confront the sanitary engineer are new chemicals such as atomic wastes and detergents, the need for improving existing works, pollution abatement, mechanization of sewage plants, corrosion, and industrial wastes.

Dean Thomas does not favor a separate society for Sanitary Engineers but does believe that there should be a coordinating council with representatives from all of the associations which now cover the field. Dean Thomas is also of the opinion that it is impossible to have specialization of sanitary engineers at the undergraduate level. He believes that sanitary engineering should have basic scientific training tied primarily to civil engineering with graduate specialization.

Air Pollution

"HEALTH IMPLICATIONS OF AIR POLLUTION" by J. J. Bloomfield, U.S. Public Health Service, Washington, D.C.

Mr. Bloomfield elaborated on the subject of air pollution and its relations to public health.

Water Resources Control

"PANEL DISCUSSION—WATER RESOURCES AND CONTROL MEASURES" led by Carl G. Paulsen, Chief Hydraulic Engineer, Water Resources Branch, U.S. Geol. Surv., Washington, D.C.

First speaker on the panel was **Malcolm Pirnie,** Cons. Engr., New York City. Mr. Pirnie pointed out that there is no real water shortage in the world. In fact, one inch of precipitation over the land areas, if stored, would give 435,000 billion gallons, enough to give 200 gal. per cap. per day for a year to five trillion persons. The problem is how to store the water to make it available in the areas where it is needed.

Mr. Pirnie spoke particularly about the water situation in the eastern part of the United States, with particular reference to the areas of New York, New Jersey, and Pennsylvania. The efforts of INCODEL are pointing the way to utilizing available water supply from the Delaware River and its tributaries.

According to **Marvin Nichols,** Cons. Engr., Ft. Worth, Tex., the state of Texas, likewise, does not have a water supply problem; it is one of storage, although the rainfall varies from 9 inches per year at El Paso to 50 inches at Beaumont. Mr. Nichols discussed public water supply needs for the 720 Texas communities and the irrigation and industrial demand. At the present time, with a billion gal. per day use, only 10 per cent of the total runoff is actually used with one per cent going to domestic use, one per cent to industrial use and eight per cent for irrigation.

Programmers

F. Thomas	*M. Pirnie*
Dean	*Cons. Engr.*
Cal. Inst. Tech.	*New York City*
Pasadena, Calif.	*N.Y.*

Other areas in the southwest are not so fortunate and in some places the withdrawal from ground water sources is fifteen times the annual recharge.

Speaking about the seven southwestern states which have an interest in Colorado River water, **Samuel B. Morris,** Gen. Mgr. and Chief Engr., said the whole area is conscious of the shortage of water. He discussed the desires of Arizona for more water from the Colorado River and the desire of California to continue to receive the amount of water which it now has under contract from that source.

The need for plenty of storage was stressed because of the wide variation in precipitation and runoff, but at best, much desirable area must remain unused because of lack of sufficient water. Mr. Morris said that California must maintain its rights to Colorado River Water and that it can not look to unproven sources such as the Columbia River, artificial precipitation, or distillation of sea water by atomic energy. Recharge of ground water supplies by purified sewage is not looked upon as a desirable method of improving such supplies.

The shortage of water in New York City has focused the attention of the country on the importance of

water supply, according to **Dr. G. Nelson Sayre,** Head, Ground Water Div., Water Resources Branch, U.S. Geol. Surv., Washington, D.C.

Dr. Nelson called attention to the great increase in water consumption or use of water. Counting irrigation

Programmers

S. B. Morris
Gen. Mgr.
Water Dept.
Los Angeles
Calif.

C. R. Cox
Chief
Bur. Water
St. H'lth Dept.
Albany, N.Y.

uses, the estimated water use today is approximately 700 gal. per cap. per day. While the population of this country has increased only 600 per cent in the past century, the water use per capita has increased by several thousand per cent.

With the probable growth of atomic energy and synthetic fuel industries, it is to be expected that water demands will increase greatly. Irrigation needs and supplemental moisture for farming are also on the increase.

While there is plenty of water in this country, the distribution is uneven. Future potential water resources are unknown but at the present time, 4/5 of the water used is from surface supplies. Dr. Nelson said that the annual rate of replenishment of reservoirs is greater than the use, but the limitations must be recognized, and we must not let overpumpage in some places discredit the safe yield of ground waters.

Dr. Nelson recommends a complete inventory of water resources and uses in this country. It is a big job and should be started now. Furthermore, there is research needed on the hydrologic cycle, on the location and prevention of brines in underground water, and on the extent of flood control and drainage problems.

Bathing Waters

"Acceptable Standards for Natural Waters Used for Bathing," by Charles R. Cox, Chief, Water Supply Section, N.Y. State Dept. of Health, Albany, N.Y.

Mr. Cox stated that there has been a tendency to adopt as an administrative guide, a value of 2400 as the MPN of coliform bacteria per 100 ml. as a median for bathing waters.

Mr. Cox spoke of sanitary surveys of each beach where approval would depend on observation of bathers' health, a satisfactory sanitary survey, and a coliform content of 2400 per 100 ml. or a content of 240 coliform per 100 ml. if the bathers' health and sanitary survey are unfavorable.

Mr. Cox also spoke of the N.Y. State Water Pollution Control Board and its present work toward developing water classifications. These classifications will be presented for public hearings at some future time this year.

Cincinnati's Problems

"Cincinnati's Sewage Disposal Plan" by H. H. Kranz, City Engr., Cincinnati, Ohio.

According to Mr. Kranz, Cincinnati not only backed the Ohio River Valley Water Sanitation Compact, but has gone forward with its plans to treat its own sewage. These plans had been interrupted by the war. The program of which Cincinnati will probably bear 85 per cent of the cost will run to possibly $35,000,000. Contracts have been entered into with 21 of the surrounding communities and the county. The program will be developed in stages and will be carried by a sewer service charge.

Radioactive Tracers

"Radioactive Isotopes in Sanitary Engineering Research" by Harold A. Thomas, Jr., and Ralph S. Archibald, Research Fellows, Harvard University, Cambridge, Mass.

Using radioactive isotopes for tracers, Prof. Thomas and Mr. Archibald studied the phenomenon of short-circuiting in settling tanks and ponds, and the flow of water in pipes. With this highly sensitive tool it was possible to actually determine the time of passage of the "salt cloud". There was no effect of density currents, and the problem of determining minute concentrations was eliminated. From these studies it was found that 100 per cent of the tracer could be accounted for. Studies such as these are still called salt velocity tests although no salt is used. Radioactive iodine 131 with a half life of eight days was the tracer used. The effects of baffling of settling tanks was studied and curves were developed to show what happens with and without baffles.

Mr. Archibald explained some of the problems of handling radioctive isotopes and the need for precautions to prevent injury to the experimenters. All studies must have the approval of the Atomic Energy Commission and be performed according to its rules and regulations.

Sewage Treatment Progress

Progress and developments in sewage treatment were reviewed in the 110 page biennial report of the Division's Committee on Sewerage and Sewage Treatment. It was presented by Langdon Pearse, committee chair-

Committee Reports

Sew. Treat.
L. Pearse
San. Engr.
San. District
Chicago, Ill.

Corrosion
R. Eliassen
Prof. San. Engr.
Mass. Inst. Tech.
Cambridge, Mass.

man, in his well known manner of evaluation of equipment and processes along with exhaustive factual reporting.

One can hardly do justice to so thorough a report as that highlighted by Mr. Pearse, but here are most of the comments made in his presentation.

The report directed attention to the number of important treatment plants under construction—notably, Los Angeles, New York City, Philadelphia, Boston, Toronto. Allegheny County Project (Pittsburgh and surrounding communities) was especially noted as being unique and remarkable in several respects. Amongst these is the setting of limitations on industrial wastes to be permitted in the sewers well in advance of sewer construction. Improvements to the Baltimore, Md. plant were hastened by a suit brought against the City. Trickling filters which have served Baltimore for 38 years are being converted to high-rate units with rotary distributors. Digested sludge is to be heat-dried.

What to do with sludge remains the big problem, said Mr. Pearse. New York City in its sludge-tanker scheme of hauling sludge to deep sea dumping grounds constitutes the simplest and probably the most economical overall method. Boston will discharge digested sludge to sea on rapid outgoing tides. Portland, Ore., with the voluminous Columbia River, will discharge digested sludge in primary plant effluent.

Chicago's conversion of sludge to fertilizer has been crippled by coal shortage and lagoons (50 acres) are proving their worth. The new Wilmington, Del. plant will depend upon lagoons for the first few years at The Milwaukee Activated Sludge

Plant is changing from coal to gas as the fuel for sludge drying at 15 cts. per 1,000 cu. ft. (Pearse didn't say whether Mr. John L. Lewis has ordered his miners never to use "Milorganite" fertilizer any longer.—Ed.). New York, with 40,000 h.p. installed,

Executive Comm.

R. H. Suttie
Prof. San. Engr.
Yale Univ.
New Haven, Conn.

R. L. Derby
San. Engr.
Water Dept.
Los Angeles, Calif.

is by far the largest user of gas engines for power development and was the first to convert to dual-fuel engines.

Sales of grease recovered from sewage continues in New York but Chicago and other cities have not been longer able to find buyers.

Pre-aeration of sewage, with or without return sludge is gaining popularity and the trend is toward larger primary tanks. The Kraus Process developed at Peoria, Ill., which involves return of digested sludge to the activated sludge process, to increase sludge density and preclude bulking, seems to have a definite value. Sludge elutriation in conjunction with dewatering on vaccum filters is growing.

Concerning activated sludge design and practice the report commented on the economy of the high-rate (short period) activation adopted as standard practice by New York City. Also it commented on the effectiveness and economy of the step-aeration method of New York City wherein sewage enters the aeration tanks at two or more points through the tanks. Chicago like New York is stopping aeration short of nitrate production. Chicago's latest design employs wide band spiral flow air diffusion with more diffusers and more air at the inlet end. Fine grain diffusers appear to give less cloggage troubles than course grained media. Milwaukee is still using fine grained plates installed 25 yrs. ago and the Northside Chicago plant has cleaned plates of 15 porosity rating once in 20 years. Slotted tubes have proved inefficient.

The oxidation method developed at Harvard Univ., and involving injection of oxygen proper, is still in the development stage, demonstrations on a pilot plant scale being needed.

Final settling tanks are larger and effluent troughs are suspended well out in the tank. Chicago's newest final tanks are circular with center inlet and radial flow.

Chlorination in its many ramifications now has a seasoned place in sewage treatment, the largest user being Detroit which averaged 5,640,000 lb. yearly with a maximum of 7,828,000 lb. per year in the past 8 years. Chemical precipation, while being used seasonally at a few plants, has been on the wane since the advent of high-rate filtration and modified activated sludge, resulting in lower plant and operating costs.

In the period just preceding and subsequent to the passage of the Federal Stream Pollution Control Act (Public Law 845) many states have passed special anti-pollution acts and have established enforcement commissions and boards. Amongst the newest is that of New York State. Industry has come along in noteworthy fashion in its endeavor to meet stream pollution requirements, the only disturbing element being the observation that the chemical men of industry appear to be trying to upset some of the long standing Sanitary Engineering Standards—a dangerous situation justifying a warning to industrial chemists and engineers.

As to patented processes, the activated sludge suits had all been settled, but at a much higher overall cost to Milwaukee and Chicago than had been anticipated. Chicago paid $1,024,000 and Milwaukee $818,000 plus costs of legal talent, experts, etc. Claims that the process was in reality discovered at the Lawrence (Mass.) Expt. Sta. of the Mass. Dept. of Health had blown up on the testimony of the assumed "inventor," who admitted on cross examination in court that he had not recognized as of practical or economic value what he had by chance observed during sewage and polluted water aeration in an aquarium.

The Guggenheim Process remains in use at only one known plant, New Britain, Conn. At East Chicago, Ind. plant alum has been substituted for iron salts.

In sewage reclamation the largest use of sewage effluents are those of Baltimore effluent by Bethlehem Steel Co., Corpus Christi and Mineral Wells, Texas. There is a decided trend toward industrial uses of purified sewage effluents in addition to irrigation in arid sections.

The trend of making special charges to industry for treatment of its wastes discharged to the municipal sewer is worthy of note. Buffalo, N.Y. and New Brunswick, N.J. were the earliest to make special charges. Chicago is now developing a schedule of charges which should net the Sanitary District $1,000,000 or more per year. It is proposed to allow 10,000 gal. per day without charge. Above this base the proposed charge is $8.00 per mil. gal. plus $2.00 per 1,000 lb. of 5 day B.O.D. over and above the allowance.

Exec. Comm.

F. S. Friel
Cons. Engr.
Philadelphia
Penna.

Program

H. W. Taylor
Cons. Engr.
New York City
N.Y.

Further commenting on accomplishments of the Sanitary District of Chicago, Mr. Pearse reported that a population equivalent of 4,000,000 by treatment works has been reduced to 1,280,000 involving $265 million plant costs. In recent times the operating costs have risen from $4.75 m.g. to $7.85 per mil. gal. the latter being reduced by $1.85 through income from sludge sales.

Mr. Pearse closed with the statement that over the next few years expenditures by cities for replacement of worn out sewage plant equipment is to be greater than ever experienced. In the Chicago plants, alone, there are 3500 electric motors and much equipment which will require replacement. He expressed the opinion that engineers should make efforts to design plants more economical to operate and maintain.

Water and Sewage Rates

The Society has no more important committee than that on Rates and Rate Structures for Water and Sewage Works under Chairman, S. A. Greeley of Chicago. In his second progress report Mr. Greeley stated that this committee was a real working group, having held two meetings of two days each in 1949 and planned at least two more such meetings in 1950 with the idea of speeding its task to completion before the year's end.

He stated that participation in the Committee's work had grown bit by bit until now eight National organizations are represented, the major interests being those of the Am. Water Works Assn., A.S.C.E., Federation of Sewage Works Assns., and Am. Public Works Assn. The Nat'l. Assn. of Utilities Commissions and the Investment Bankers Assn. are the latest organizations to be accorded participation.

The objectives of this Committee are to set up fundamental considerations and requirements in developing water rates and sewer service charges based on equitable proportioning of *true* costs to water takers and sewer users. It constitutes a broad attempt to correct the amazing confusion and great diversity of rates for water service.

Assignments have been given various members of the Committee to produce chapters on the following—

(1). Definitions
(2). Functions of Water Works
(3). Functions of Sewage Works
(4). Public vs. Private Utilities
(5). Financing and Fair Rate Structures
(6). Annual Revenue Requirements
(7). Existing Rate Structures
(8). Recommended Rate Structures
(9). Enforcement of Charges

As stated previously, the report is scheduled for completion before the year's end.

Corrosion in Water Systems

A new Committee is being established in the San. Eng. Div.—"COMMITTEE ON CORROSION OF DISTRIBUTION SYSTEMS AND OTHER WATER WORKS FACILITIES" under chairmanship of Prof. Rolf Eliassen of the Mass. Inst. of Technology.

Prof. Eliassen did not announce the membership of the new committee, but outlined the many facets of corrosion and needs for more adequate control of this depreciating and debilitating "water works disease."

While the pH index of saturation had been a useful tool in corrosion control it lacked in effectiveness because the *rate* of corrosion was not indicated by this method of control. In respect to the effects of dissolved oxygen Prof. Eliassen revealed that corrosion would generally increase with oxygen increase up to the saturation point but without adequate explanation a super-saturation with oxygen reduces corrosion until at 20 ppm. dissolved oxygen corrosion is completely suppressed in cold water systems.

While cement lining of pipe lines of 24 inch diameter and larger had proved practical and economically advantageous, there was need for further development and wider application of methods for protective lining of mains of under 24 inch diameter. Chemical treatment to control corrosion had been less successful than desired and a general improvement in understanding of basic requirements in chemical control would be an objective. The same held in respect to Cathodic protection practices and devices. Methods for suppressing forms of corrosion and tuberculation traceable to biologic organisms and growths through chlorination or other methods of disinfection or sterilization needed study, with the objectives being a better understanding of cause, effect and control measures.

Another committee is being organized under Chairmanship of Henry W. Taylor, of New York. In his organization report and assignment of work to the numerous sub-committees Mr. Taylor launched the new Committee on Refuse Collection and Disposal. As far as was evident it is not proposed that this committee function jointly with or even in liason with similar Committees of other national associations. One of its functions will be that of evaluating garbage disposal by way of sewer systems and treatment plants. Another will be power and other by-product developments from garbage.

Officers

The Executive Committee of the Sanitary Engineering Division for the ensuing year will consist of the following:

Chairman: A. H. Wieters, Stream Pollution Control Sect., San. Engr. Div. U.S. Pub. Health Service, Washington; *Secretary:* Frank W. Jones, Partner, Havens and Emerson, Cons. Engrs., Cleveland, Ohio; R. H. Suttie, Prof. of San. Engr., Yale University, New Haven, Conn.; Ray L. Derby, San. Engr., Los Angeles Water, Light and Power Dept., Los Angeles, Calif.; and Francis S. Friel, Cons. Engr., Philadelphia, Penna.

Water Treatment Operators' Course

Rensselaer Polytechnic Institute, Troy, N.Y. will hold a Special Course for Grade II Operators of Water Treatment Plants between Mar. 20 and April 1. The course is sponsored by the Municipal Training Institute of N.Y. State and administered by the N.Y. State Conference of Mayors. Cooperating in the presentation of the course is the N.Y. State Dept. of Health. A number of these courses were held before the war, but this is only the second one since 1948.

The course will be under the immediate direction of E. J. Kilcawley, Prof. of San. Engr. and will be held in the Troy Building located on the Institute Campus.

Depending on the size of the enrollment, the fee will range from $20 to $30 per student. Students will either furnish their own texts (Hardenbergh's "Water Supply and Purification", "Standard Methods" and Theroux, Mallman, and Eldridge "Laboratory Manual") or have to buy them.

Application for enrollment may be made either to Morgan Strong, Exec. Secy. Conf. of Mayors, 6 Elk St., Albany, N.Y. or to Prof. E. J. Kilcawley, Rensselaer Ploytechnic Inst., Troy, N.Y.

What Bloodgood Did Say

(A Correction)

In his review of progress in the treatment of pulp and paper products wastes in the Federation of Sewage Wks. Assn's. symposium on industrial wastes, Prof. Don. Bloodgood of Purdue Univ. was credited on page 40 of our January issue with stating that sedimentation and high-rate trickling filters (pilot plant) had successfully reduced the B.O.D. of straw-board wastes at Terre Haute, Ind., from 1000 ppm. to an average of 87 ppm. in the final effluent.

Prof. Bloodgood was apparently misunderstood. A paragraph cited in his prepared statement reveals that the pilot plant studies to date have shown that trickling filters are *not* suitable for the treatment of strawboard wastes. The process reported as being successful in converting strawboard wastes of roughly 1000 B.O.D. into effluents averaging 87 ppm. B.O.D. was a laboratory study of an anaerobic fermentation process, involving periods of 1.9 to 3.8 days during passage through the digestion units.

Prof. Bloodgood was credited with answering a floor question to the effect that chemical precipitation produced a 45% reduction in 5 day B.O.D. vs. only 15% with plain sedimentation. It, appears that this statement was made by another participant in the discussion whose identity is a blank in the reporter's notes.

We regret very much having failed to catch the all important *"not"* in Prof. Bloodgood's comments on the applicability of the trickling filter in treatment of the strong alkaline wastes from strawboard production. It must have been one of those occasions on which this reporter was trying to listen with one ear to a neighbor while listening with the other to the floor discussion. In any case Prof. Bloodgood is due our apologies for having so completely misquoted him.

INDUSTRY AND POLLUTION ABATEMENT

Policies, Problems and Progress in the Ohio River Valley

by

EDWARD J. CLEARY

Executive Director & Chief Engineer

OHIO RIVER VALLEY WATER SANITATION COMMISSION

CINCINNATI, OHIO

SOME people are saying that the pollution-abatement program in the Ohio River basin is destined to call a halt to further industrial expansion. Such a statement is startling to anyone interested in industrial production or industrial waste treatment, but I heard exactly that idea from a delegation of industrial-promotion men who called upon the Commission.

It occurred to me, therefore, that it might be useful to relate what transpired at that meeting. In so doing, questions in the minds of many persons regarding the objectives and operations of the Ohio River Valley Water Sanitation Commission may be clarified.

First, a bit of background: Shortly after this Commission had been organized, a major chemical concern, let's call it the "X" Company, sought a permit from one of the states in the valley to dispose wastes from a proposed new plant. In its application the company furnished an analysis indicating that wastes would be large in volume and would contribute a substantial amount of hardness to the Ohio River flow; furthermore no method of disposal other than controlled dilution was offered.

Obviously, here was a potential pollution situation of concern to more than one state. With the Commission established, the matter was placed before the chief sanitary engineers of the states affected. This led to a study following which unanimous agreement was reached that a permit for this operation should be denied.

Backed with such support the health authorities in the state wherein "X" Company sought to locate, refused to sanction operation of the plant without adequate provisions for waste disposal. As a consequence, the company decided it would not go ahead with its building program.

A lot of people had worked hard to attract this industry to consider that

The Author

state. And you can be sure that they had a lot of questions to ask when the project was stymied because of pollution-abatement requirements. Thus it was that the state director of commerce and top representatives from the state Chamber of Commerce, a major railroad, and a power company, came to Cincinnati to talk over the situation.

How Does Commission Operate?

First came this question: How does the Commission operate? That was an easy one to handle. The Commission is composed of representatives from eight states, which had signed a compact in June 1948, that pledged their "faithful cooperation in the control of future pollution and in abatement of existing pollution from the rivers, streams and waters in the Ohio River basin . . . . . "

The eight states are Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia. Each state is represented by three commissioners, appointed by the governor. In addition, there are three federal commissioners, appointed by the President of the United States, representing the Surgeon General of the U. S. Public Health Service, the U. S. Army Engineers, and the Fish and Wildlife division of the Department of the Interior. The role of the commissioners is to establish policies for carrying out the provisions of the Compact.

One of these policies enunciates this principle: Objectives of the Commission will be accomplished whenever possible through the use of or through cooperation with the established regulatory agencies of the states. This means that Commission operations are designed to supplement rather than overlap those of existing state health departments or other state water-control agencies.

Thus, municipalities and industries will continue to deal directly with these agencies, as they have in the past, regarding compliance with pollution-abatement measures. However, coordination of individual state programs, the pooling of information and the direction of area-wide activities are the functions of the Commission.

A good illustration of state and Commission relationships is provided in handling the case of Company "X". Here an upriver state was faced with the decision regarding a permit for discharge of a pollutional waste. The industry concerned made its representations to the state sanitary engineer. He, in turn, called upon the Commission to conduct a study of the effect of this waste downstream, to present these findings to the other state sanitary engineers and to ask for their opinions. Since the conclusion reached by representatives of the signatory states was unanimous and the company apparently accepted it, there seemed to be no further need for a public hearing or other Commission action on the matter.

Public Hearings and Power of Enforcement

That brought forth the second question: What about public hearings and the power of enforcement by the Commission? The answer to this was a little more involved.

Provision is made in the Compact for the conduct of two types of public hearing:

(1) Hearings are required in cases where the Commission may find it in the public interest to require a higher degree of treatment than the minimum prescribed in the Compact. This minimum, incidentally, is "substantially

*Presented at the 5th Purdue University Industrial Waste Conference and here published by permission.

complete removal of settleable solids and the removal of not less than 45 per cent of the total suspended solids . . . . . " Since its establishment in June 1948, the Commission has conducted only one public hearing of this type. This was based on a finding that waters in the 22-mile stretch of the river known as the Cincinnati Pool called for greater removal of B. O. D. than would be afforded by primary treatment.

(2) A public hearing is also called for should the Commission find it necessary to issue an order through the appropriate courts for corrective measures upon any municipality or corporation.

It is the Commission's hope, of course, that it will achieve its objectives through persuasion and education. When and if this approach proves ineffective, appropriate legal compulsion can be initiated. This action is taken following the assent of a majority of the Commissioners from not less than a majority of the states, as well as the approval of a majority of the Commissioners from the state in which the order is to be issued. In terms of numbers this means that two commissioners from each of five states, or a total of ten, must agree; and in addition there must be included a favorable vote from two of the three commissioners from the state affected.

It is of more than passing interest to point out that this unusual power-of-enforcement clause captured the attention of delegates to the Academy of International Law at The Hague during a seminar this past summer. The Ohio River Valley Water Sanitation Compact was cited as having been "born with perhaps the strongest teeth of any American interstate organization, indeed stronger than any international organization . . . . . " And there was also this profound observation: " . . . the Commission's power to invoke the strong sanction of enforcement is the best guarantee that only rarely will it need to be exercised".

"This is all very fine," said the industrial delegation, "but why didn't you hold a public hearing in the case of Company 'X'?" The obvious answer, of course, was that the company apparently accepted the state ruling and did not request a public hearing by the Commission. Incidentally, the Commission saw no gain to anyone in having the matter publicized in a hearing or through the press. This particular company was one of national standing. Any publicity focusing attention on the fact that it was seeking to operate a plant that would pollute or otherwise affect the water quality of a major river could hardly be construed by the company as contributing to its best interests.

While the Commission is fully aware of the power of aroused public opinion it does not propose to use such means to achieve its ends unless it is compelled to do so. Since the "X" Company showed no desire or reason to air its case before the public, the Commission had no cause to feel otherwise.

Interest in Industrial Waste

All of which led to another question: "Why does the Commission involve itself with industrial wastes when its title would connote concern only with sanitation matters"?

This was very significant. It had never occurred to me that certain people viewed industrial wastes as something quite apart from other wastes that contribute to the degradation of water quality. I'm sure the question relating to the Commission's concern with industrial wastes was asked in all sincerity because a remark was then made that nobody ever got sick drinking hard water. Why, therefore, should the Commission take a stand on the matter of additional hardness in a river?

This led to a discussion outlining the following view: It was not so much the additional hardness from Company "X" that would work a serious hardship. But it was the cumulative amounts of hardness from all the plants to be built in the future that could eventually create a severe economic burden on every user of river water. If Company "X" had been given permission to dump its wastes, then the same privilege would necessarily have to be accorded every other plant that sought it.

Waste Treatment and Economic Competition

Emphasis was now shifted from health and sanitation aspects to a question on which industry could speak with unimpeachable authority. In fact, this was not a question; it was a statement, which said in effect: If the Commission enforced pollution abatement and forbid the discharge of wastes into streams it would put every industry in the Ohio River Basin at a competitive disadvantage with the rest of the country.

This statement was open to challenge in several respects. First, the Ohio Basin enjoys a special position with regard to raw materials, geographic location and labor supply that probably is not duplicated elsewhere. Second, the majority of the states in the Basin are signatories to the Compact and are operating, or about to operate, under similar pollution-abatement restrictions. Furthermore, adjacent states either have comparable legislation or are in the process of drafting more effective pollution-abatement laws. As a consequence, it did not appear at all likely that an industry could find a location where it might enjoy indiscriminate dumping of its wastes. Public opinion has advanced too far to countenance such conditions, as evidenced by strengthened anti-pollution measures in the states and the existence of federal legislation for this purpose.

Instead of a competitive disadvantage from pollution abatement, it might be argued that industry stands to gain competitive benefits from stream-cleanup. There is hardly an industry that would not be in a stronger profit-making position if it could get better water at lower cost. Most industries are paying a substantial premium to have their present raw-water supplies converted into a product suitable for their use. And the more polluted the source, the higher the premium. In fact, there is abundant evidence that one of industry's most critical problems today is to assure itself of an adequate and desirable supply of water. Anything, therefore, to insure this condition, such as pollution-abatement, would seem to favor industry rather than penalize it.

By-product Recovery

There is always the probability that under the compulsion to do something about its waste problem an industry may reclaim a by-product, or at the very least, make substantial reductions in the amount of waste.

There is nothing academic in this statement: Look what happened in the distillery industry. Waste-recovery measures have resulted in the production of a cattle food that now commands more than $100 a ton. I don't know what the profit margin is but it is certain that the distillery people are not unhappy about pollution abatement.

Another example, this time a steel company in the Ohio valley. After years of opposition to the installation of works for handling blast furnace flue-dust that was being dumped into the river, a treatment plant finally was built at a cost of $516,000. In the very first year of operation this plant recovered enough ore dust not only to pay for its operation, but to yield, in addition, a net profit of $581,000!

And finally, this story told me by a chemical company executive. He said, confidentially, his firm was deeply indebted to a certain state health depart-

ment because of a court order to abate pollution. This compulsion led to an intensive study of the problem which revealed that this particular waste was high in vitamin content. Today this plant has shifted its processing to extract vitamins and the material formerly produced has been relegated to the position of a by-product.

It is situations such as these that lead me to wonder if industry has been doing itself a great disservice by not giving more attention to what goes in and what comes out of its sewers. If one of our most powerful drugs can be extracted from a piece of moldy bread, you might let your imagination run riot with the potentialities in some of the things that now do nothing more than defile our streams.

Help For Small Industries

One last question came up in our conference: If the Commission seeks to have industry take steps to install treatment works is it prepared to help and abet industries—particularly small ones—in seeking solutions for waste problems.

More than complete assurance could be given on this score. Already the Commission had embarked on such a program, although it has hardly been in operation more than a few months.

One of the problems to which it is directing immediate attention is phenol elimination—not only of major concern in the Ohio valley but an industrial-waste problem of national significance. In this connection the Commission is acting in the role of director and coordinator of every resource that can be brought to bear on the problem.

Progress thus far has been very encouraging. The Commission has joined forces with the Wallace & Tiernan Co., the Armco Steel Corp. of Middletown and the Ohio State Department of Health in a joint venture. The Armco people have erected a small laboratory building adjacent to their by-product coke plant to facilitate investigations. Here, an engineer of the Commission staff, two members of the Wallace & Tiernan research organization, three chemists of the Sanitary Engineering division of the Ohio Health Department and several members of the Armco industrial-waste committee have made some significant laboratory findings in a period of just a few days. At this moment it appears that pilot-plant operations are justified.

Here, then, is an example of how the Commission seeks to coordinate the resources, skills and interests of private industry and public agencies on problems of mutual interest. Other projects are now in the planning stage.

May I add that the Commission is not setting itself up as a research agency. It has neither the funds nor the personnel to operate laboratories. Furthermore, as a matter of policy, the Commission has gone on record to state that it does not propose to engage in laboratory research. It firmly believes that existing state, federal and other established centers of research are readily available and eminently qualified to carry on such work.

Furthermore, the Commission believes, and has evidence to show, that industries do not expect this Commission or any other regulatory body to provide solutions for their waste-disposal problems. But the Commission accepts the responsibility that it should inspire and coordinate all efforts that will aid industries and municipalities in furthering stream clean-up at reasonable cost and as quickly as possible.

The Commission is sympathetic to the special problems of the smaller industries, with their limited staffs and research skills. It will seek to develop cooperative ventures on waste disposal among similar types of industry, particularly in conjunction with existing trade organizations.

It is not amiss to point out that the very composition of the Commission membership assures industry an adequate opportunity to register its views. Industry has five able spokesmen on the board of commissioners. Other members include outstanding professional men representing the fields of public health, fish and wild-life conservation, engineering, the legal profession and the press. Thus in the formulation of policy and the promotion of remedial measures the Commission will enjoy the benefit of a wide variety of viewpoints.

It was on this note that the meeting came to a close. I feel safe in saying that the industrial delegation had a clearer picture of the Commission operations. And this led to some practical suggestions whereby their efforts and ours might be integrated in working on problems of mutual interest.

As for the Ohio River Valley Sanitation Commisson, the meeting provided one of the best opportunities it has had to tell its story. It is a story that will have to be told many times because the audience to be reached is a vast one that encompasses millions of people and thousands of industries.

More important than the story, however, is the message that it brings. For the Ohio River valley this message is one of great hope—the promise for prompt restoration of clean waters through the united efforts of the states, their people and industries.

"THREE WATERWORKS WEIRS"

("Vic") ("Bill") (Paul)

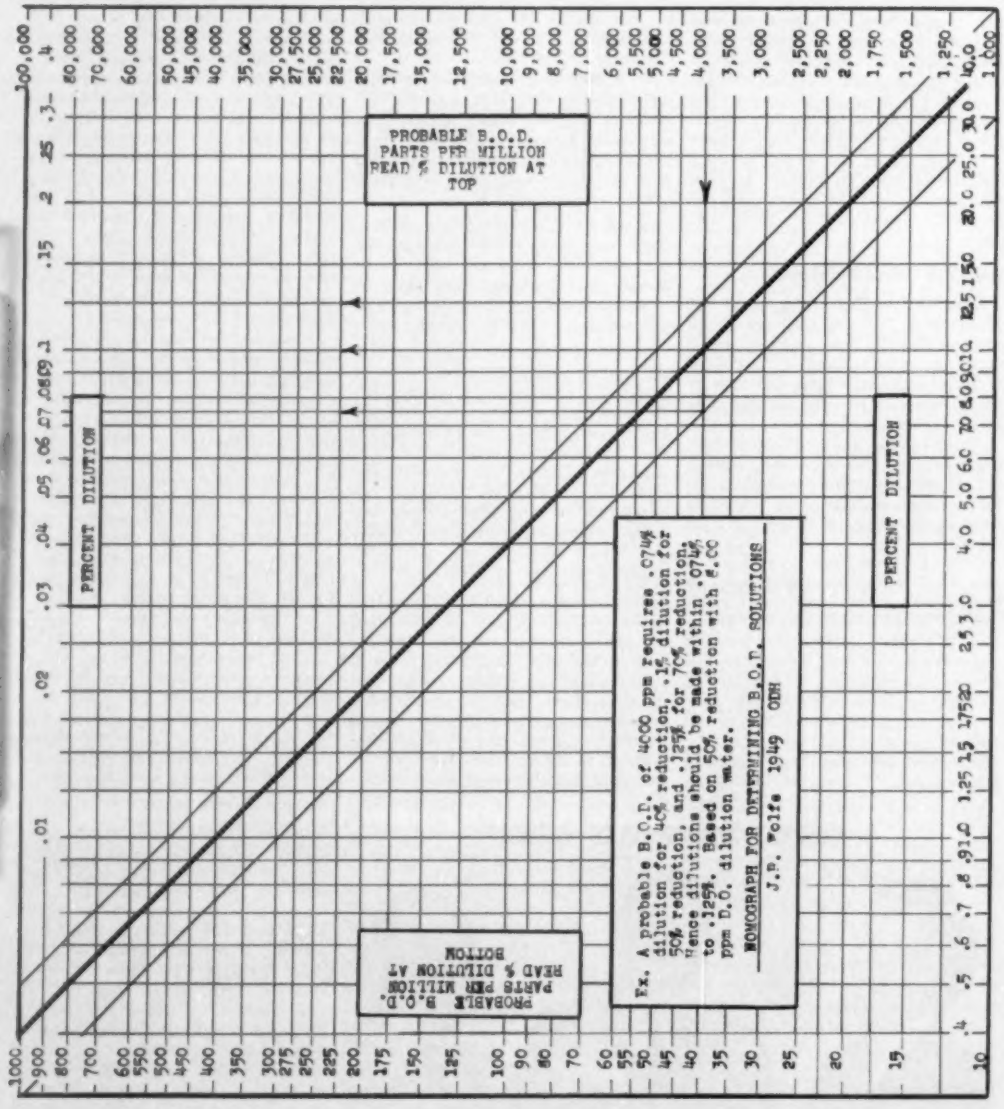
(Photo by Jack Holland, Albany, Ga.)

This assemblage of the "Three Waterworks Weirs" occurred recently at A.W.W.A.'s Southeastern Section Annual meeting in Albany, Ga. "Vic" now Vice-President of A. W.W.A., is President and General Manager of the St. Louis County Water Co. and the Missouri Water Co. "Bill," who is Sanitary Engineer, Ga. State Dept. of Health, for a number of years was the proficient Secy.-Treas. of the Southeastern Section and is a Past Director of A.W. W.A. Paul, a Past Director of A. W.W.A. and "spark-plug" in the Southeastern Section, is General Manager of Atlanta's Water Department. All are real "wheel-horses" of which A.W.W.A. can well be proud.

Enthusiasm is the genius of sincerity, and truth accomplishes no victories without it.

BULWER LYTTON

NOMOGRAPH FOR DETERMINING PROPER DILUTION IN THE B.O.D. TEST


PROBABLE B.O.D.
PARTS PER MILLION
READ % DILUTION AT
TOP
PERCENT DILUTION
PERCENT DILUTION
PROBABLE B.O.D.
PARTS PER MILLION
READ % DILUTION AT
BOTTOM
Ex. A probable B.O.D. of 4000 ppm requires .07% dilution for 40% reduction, .15% dilution for 50% reduction, and .125% for 70% reduction. Hence dilutions should be made within .07% to .125%. Based on 50% reduction with a 300 ppm D.O. dilution water.
NOMOGRAPH FOR DETERMINING B.O.D. SOLUTIONS
J.R. Wolfe 1949 ODH

In making the Biochemical Oxygen Demand Test it is desirable to make up the dilution of the sample so that not more than 70% nor less than 40% of the dissolved oxygen in the diluted sample will be used up during the incubation period of 5 days. As an aid in choosing the proper dilutions for the 5-day B.O.D. Test the above nomograph has been developed by John R. Wolfe, Ass't. Engr., Ohio State Dept. of Health.

GRAPHICAL DETERMINATION OF B.O.D. CURVE CONSTANTS

by

HAROLD A. THOMAS, JR.,

Assoc. Prof. of Sanitary Engineering

HARVARD UNIVERSITY

A NUMBER of methods have been described for determining the constants k and L of the B.O.D. equation $y=L(1-10^{-kt})$. These constants measure respectively rate of biochemical stabilization and total amount of putrescible matter present. The selection of a particular method to be applied to a given set of experimental results should be based upon the reliability of the data and upon the degree of precision required. The usual methods involve an amount of calculation that may be excessive when applied to data from which no high degree of precision in the evaluation of the constants k and L is needed or desired.

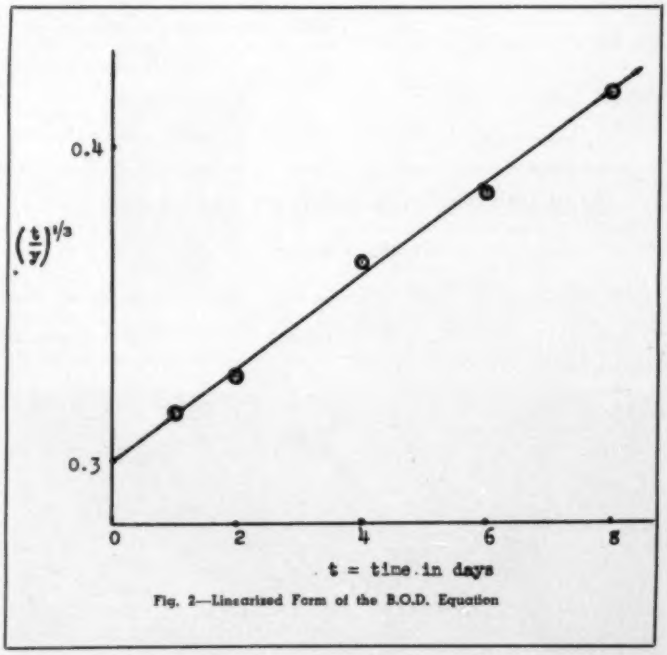


Fig. 2—Linearized Form of the B.O.D. Equation

Simple Method

The following method is simple, it involves no cut-and-try procedure, it uses all of the experimental determinations, and it may be carried out by means of a slide rule in a few minutes. Results are in good agreement with those obtained by more elaborate least squares methods.

The method stems from the similarity of the two functions $[1-10^{-kt}]$ and $(2.3kt[1+(\frac{2.3}{6})kt]^{-3}$ that may be seen in their respective series developments:

$$\left[1-10^{-kt}\right]=(2.3kt)\left[1-\frac{1}{2}(2.3kt)+\frac{1}{6}(2.3kt)^2-\frac{1}{24}(2.3kt)^3+\ldots\right] \quad (1)$$

$$(2.3kt)\left[1+(\frac{2.3}{6})kt\right]^{-3}=(2.3kt)\left[1-\frac{1}{2}(2.3kt)+\frac{1}{6}(2.3kt)^2-\frac{1}{21.6}(2.3kt)^3+\ldots\right] \quad (2)$$

The first three terms in the two series are identical and the difference between the fourth terms is small. Replacing (1) by (2) in the B.O.D. equation, the following approximate relation is obtained:

$$y=L(2.3kt)\left[1+(\frac{2.3}{6})kt\right]^{-3} \quad (3)$$

Rearranging terms and taking the cube root of both sides, equation (3) may be transformed as follows:

$$(\frac{t}{y})^{1/3}=\frac{1}{(2.3kL)^{1/3}}+\frac{(2.3k)^{2/3}}{6L^{1/3}}t \quad (4)$$

Equation (4) is *linear* in $(t/y)^{1/3}$ and t.

The intercept and slope of equation (4)—(See Fig. 1)—are defined by symbols

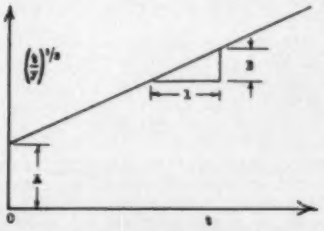


Fig. 1—Intercept and Slope of Equation 4

$$A=(1/2.3kL)^{1/3} \quad (5)$$

$$\text{and } B=(2.3k)^{2/3}/(6L^{1/3}) \quad (6)$$

The procedure in determining the B.O.D. constants consists of the following steps:

(i) From the experimental results, y and t, calculate the value of $(t/y)^{1/3}$ for each day.

(ii) Plot $(t/y)^{(1/3)}$ vs t on arithmetic graph paper and by eye draw the straight line of best fit.

(iii) From the plot measure the intercept A and the slope B.

(iv) Finally, calculate k and L from the equations

$$k=(2.61B)/A \quad (7)$$

$$\text{and } L=1/(2.3kA^3) \quad (8)$$

which follow from equations (5) and (6).

Example. The following B.O.D. results were observed on a sample of raw sewage at 23°C:—

t = time, days	0	1	2	4	6	8
y = B.O.D., ppm.	0	32	57	84	106	111
$(t/y)^{1/3}$	–	0.315	0.327	0.362	0.384	0.416

From Fig. 2.

$$A = 0.30 \text{ and } B = \frac{0.416 - 0.300}{8 - 0} = 0.0145$$

Substituting in equations (7) and (8),

$$k = \frac{2.61(0.0145)}{0.30} = 0.13 \text{ per day}$$

$$L = \frac{1}{2.3(0.13)(0.30)^2} = 124 \text{ ppm.}$$

The foregoing values are in satisfactory agreement with those obtained by a least squares procedure, namely, k = 0.14 per day and L = 121 ppm.

The method does involve an element of subjectivity — that entailed in fitting a straight line by eye. This does not ordinarily introduce large errors. Thirty-six different calculators reported k-values for the foregoing data varying from 0.114 to 0.148; usually two different calculators obtain results that do not differ by more than one unit in the second decimal place.

Because of the lack of complete similarity between functions (1) and (2), the points on the linearized plot (Fig. 2) theoretically deviate slightly from a straight line. Such deviation, however, is not appreciable until the B.O.D. is about ninety percent exerted. Consequently experimental points with y-values exceeding 0.9L should not be used in fitting the straight line. In the foregoing example all of the points had y-values less than 0.9(124), and it may be seen that they exhibit an excellent degree of linearity.

The graphical method may be used with any measuring units—for example, B.O.D. in pounds and time in hours; it is valid in any range of values of the B.O.D. constants.

NEW METHOD FOR CUTTING CLAY PIPE

by

REUBEN F. BROWN*

Most contractors and sewer maintenance men use a hammer and chisel for cutting clay pipe. This method leaves a ragged edge and will cause a poor joint in bell and spigot pipe. It also is slow and inaccurate—pipe sometimes being damaged due to not cutting deep enough with the chisel before breaking off the short ends.

A new cutting method has been tried out with great success on clay pipe, particularly the "Ceramicweld" pipe which is a butt end pipe connected with rubber gasket joints. (See article describing this flexible joint in W.&S.Wks. for Dec. 1949—page 486.) A cutter similar to that used on steel pipe is employed. Set in the chain are the little cutting wheels. The chain makes it simple to set the pipe on end, and go round and round tightening up on the cutter handle until a groove has been cut in the pipe as if it had been sawed in two. It takes about a minute and a half to two minutes to cut a clay pipe without danger of cracking it.

Pipe Cutter Ready to Start Cutting.
(Note Smooth Edge on Cut Pipe on Right.)

This particular pipe cutter, known as the "SPRING-LOAD" is manufactured by the Spring-Load Mfg. Corp. of Seattle, Wash. Our No. 6 size is for pipe from 2 to 6 inches in diameter and the No. 12 size handles pipes from 4 to 12 inches in diameter. We understand that this same cutter has been very successfully used for cutting asbestos-cement pipe.

The accompanying picture illustrates how the cutter works and the excellent smooth edge that it leaves when the pipe has been cut.

*Sup't., Sewer Maintenance, Los Angeles Dep't. Public Wks.

A. D. Weston Retires From Mass. Dept. of Health

Succeeded by Clarence I. Sterling

Arthur D. Weston, retired on Jan. 1, as deputy commissioner and director of the division of sanitary engineering of the Mass. Dept. of Health. Mr. Weston has long been active in several technical associations and has served on many committees of national import in the field of sanitary engineering and public health. He plans to write about the work of the department and the Lawrence Expt. Sta. and to do some consulting work.

Mr. Weston will be succeeded in the post of Director by Clarence I. Sterling, who resigned as director of the division of health and sanitation of the Institute of Inter-American Affairs in Washington. Mr. Sterling, with a rank of Prin. San. Engr. in the Mass. Dept. of Health, has been on leave of absence since 1942 to work with the Institute of Inter-American Affairs.

DETERMINATION OF METALS IN INDUSTRIAL WASTES[1]

Part I—Iron and Copper

Part 2 will deal with Chromium, Vanadium and Cyanides

by

H. GLADYS SWOPE[2] T. JAFFE[3] AND MARY O'CALLAGHAN
ALLEGHENY COUNTY SANITARY AUTHORITY
PITTSBURGH, PA.

IN THE analysis of industrial waste samples it was found that the ordinary methods of analysis were not always applicable. Many of those given in the water section of "Standard Methods for the Examination of Water and Sewage" were not always suitable without modification.

It should be pointed out, too, that the methods given here may not be the last word in an analysis for any particular element inasmuch as there was an enormous amount of work to do in a short time. Not all of the methods for any one element were tried nor was a thorough search of the literature made.

The analyses which will be discussed are those for iron, copper, chromium, vanadium and cyanide. The latter, of course, is not a metal but was one of the most difficult determinations to make and was important in the Pittsburgh area.

An industrial waste may be defined as the water-borne waste from an industry—it therefore may contain anything; its composition being limited only to the manufacturing processes of the particular industry.

In most instances the metals present are in minute quantities, less than 1.0 part per million (ppm.) and 1.0 ppm. is only 0.0001 per cent; a small amount indeed when one considers that in the metal industries the analyses used are for upwards of one per cent.

In sewage treatment processes the elements of interest are those which hinder such processes. In stream pollution work those elements which are toxic to fish life must be considered.

Iron is detrimental to a sewage plant using the activated sludge process if porous plates are used since it stops up the pores of the plates necessitating frequent cleaning. The amounts of iron which will do this have been indicated to be between 2 and 32 ppm. [1]

The Senior Author

Copper is toxic; therefore it hinders biological action. A recent paper by Plack, Ruchhoft and Snapp [2] of the U.S. Public Health Service showed that amounts as low as 0.01 ppm. of copper appreciably reduced the biochemical oxygen demand (B.O.D.) and that 0.05 ppm. of copper reduced the B.O.D. by about 23 per cent.

Beyond 0.3 ppm. of chromium the B.O.D. is inhibited. "The percentage of the true B.O.D. obtained with additional chromium present decreases to about 80 per cent at a concentration of 0.9 ppm. chromium. . . . Amounts of chromium as low as 0.05 ppm. repress nitrification . . ." [2]

Under certain conditions vanadium inhibited biological action in quantities as low as 0.25 ppm. and all tests showed that 1-2 ppm. inhibited the B.O.D. [2]

Cyanides of course, are toxic.

Because of the minute quantities of metals present in industrial wastes and the fact that most wastes are 99.9 per cent water the sample was concentrated from 1-2 liters or more to 100-250 ml. If absolutely nothing or almost nothing is known about the waste, then a qualitative analysis first saves time since many determinations are inaccurate in the presence of other elements. If one has a spectrograph, 1-2 liters may be evaporated to dryness or concentrated to a small volume, and the elements present determined in this way.

IRON

In most cases the determination of iron in industrial wastes caused less difficulty than any other single determination since most of these samples contained appreciable quantities of iron and the Zimmerman-Reinhardt method could be used.

So much time and research was spent in obtaining a satisfactory method for iron in river water and sewage samples, that when industrial waste samples with low iron concentration were received it was only the preparation of the samples for the colorimetric determination with ϕ phenanthroline [1] that caused trouble. It was found that digestion with sulfuric acid was required. The method which was found entirely satisfactory is outlined below:

Procedure for Iron

1. Use a sample (50 to 100 ml.) containing at least 0.01 mg. total iron and place in a 250 ml. Erlenmeyer flask.
2. Add 4 to 6 ml. concentrated sulfuric acid; digest under the hood and take to dryness. Digestion must be continued until no fumes are given off when any part of the surface of the flask is heated.
3. Take up the sample with 5 ml. of 3N hydrochloric acid, after cooling. Dilute to about 50 ml. Boil for 5 to 8 minutes, or until the volume is between 10 and 15 ml.
4. Filter through Whatman No. 2 filter paper, retaining the filtrate.
5. Add 2 ml. of 10 per cent hydroxylamine hydrochloride and 2 ml. of 0.5 per cent ortho-phenanthroline.
6. Adjust pH to between 5 and 6 with 50 per cent sodium hydroxide. Any pH between 4 and 8 is satisfactory, however.
7. Transfer to a 100 ml. volumetric flask and make up to the mark.
8. Allow to stand ½ hour, then read at 508mμ, determining either density or % transmission.

[1]Presented before the Pittsburgh Section of Analytical Chemists, Pittsburgh, Pa.
[2]Present address: Argonne National Laboratory, Chicago, Ill.
[3]Present address: Buck, Seifert and Jost, San Juan, Porto Rico.

9. Determine ppm. iron from a previously constructed curve of concentration vs. density or % transmission. (See Fig. 1).
10. Read against a blank, using all reagents, and prepared as above.

Note: When interfering ions are present these must be removed. These interferences are removed in step 2 above after the sample has been fumed to clearness with concentrated sulfuric acid. Care must be taken that the sample contains only known amounts of acid when the hydroxylamine hydrochloride and o-phenanthroline are added; otherwise it should first be fumed to dryness with sulfuric acid and taken up in dilute hydrochloric acid. Regular analytical methods for the separation of ions are employed on the sample after it has been fumed to dryness with concentrated sulfuric acid.

It was found that much more reproducible results were obtained through the use of the o-phenanthroline [7] method than by the thiocyanate method. Fortune and Mellon [8] have listed the amounts of interfering ions with this method as shown in Table 1.

Although the work was done in this laboratory with the Beckman sepctrophotometer, the Fisher electrophotometer could be adapted to this work by using a color filter covering the wave-length 508 mμ. A calibration curve for the instrument used, would have to be made. Visual comparisons, of course, can be made by running a set of color standards each time the iron determination is made. This takes more time and is less accurate inasmuch as the personal factor is involved.

Table 1

EFFECT OF CATIONS

Cation	Added As	Max. Conc. ppm.	Max. Interfer. % Iron	Applicable pH Range
Aluminum	$AlCl_3$	500.0	None	2.0-3.0
		250.0	1.4	2.0-5.0
Ammonium	NH_4Cl	500.0	None	2.0-9.0
Antimony	$SbCl_3$	30.0	None	3.0-9.0
Arsenic	As_2O_3	500.0	None	3.0-9.0
	As_2O_5	500.0	None	3.0-9.0
Barium	$BaCl_2$	500.0	None	3.0-9.0
Beryllium	$Be(NO_3)_2$	500.0	1.3	3.0-5.5
Bismuth	$Bi(NO_3)_3$	None	.....	.....
Cadmium	$Cd(NO_3)_2$	50.0	1.0[a]	3.0-9.0
Calcium	$Ca(NO_3)_2$	500.0	None	2.0-9.0
Chromium	$Cr_2(SO_4)_3$	20.0	None	2.0-9.0
Cobalt	$Co(NO_3)_2$	10.0	1.5	3.0-5.0
Copper	$Cu(NO_3)_2$	10.0	None	2.5-4.0
Lead	$Pb(C_2H_3O_2)_2$	500.0	None	2.0-9.0
Lithium	$LiCl$	500.0	None	2.0-9.0
Magnesium	$Mg(NO_3)_2$	500.0	None	2.0-9.0
Manganese	$MnSO_4$	500.0	None	2.0-9.0
Mercury	$HgCl_2$	1.0	None	2.0-9.0
	$Hg_2(NO_3)_2$	10.0	None	3.2-9.0
Molybdenum	$(NH_4)_6Mo_7O_{24}$	100.0	None	5.5-9.0
Nickel	$Ni(NO_3)_2$	2.0	None	2.5-9.0
Potassium	KCl	1000.0	None	2.0-9.0
Silver	$AgNO_3$	None	.....	.....
Sodium	$NaCl$	1000.0	None	2.0-9.0
Strontium	$Sr(NO_3)_2$	500.0	None	2.0-9.0
Thorium	$Th(NO_3)_4$	250.0	1.5	2.0-9.0
Tin	H_2SnCl_6	20.0	None	3.0-6.0
		50.0	None	2.5
	H_2SnCl_2	10.0	None	2.0-6.0
		20.0	None	2.0-3.0
Tungsten	Na_2WO_4	10.0	Negligible	2.5-9.0
Uranium	$UO_2(C_2H_3O_2)_2$	100.0	None	2.0-6.0
Zinc	$Zn(NO_3)_2$	10.0	None	2.0-9.0
Zirconium	$Zr(NO_3)_4$	50.0	1.8	2.0-9.0
		100.0	2.2	3.0-9.0

[a] 15.0 ml. of o-phenanthroline in excess of the original amount added. Iron reduced with hydroxylamine hydrochloride in all tests.

EFFECT OF ANIONS

Anion	Added As	Max. Conc. ppm.	Max. Interfer. % Iron	Applicable pH Range
Acetate	$NaC_2H_3O_2$	500.0	None	2.0-9.0
Tetraborate (as B_2O_3)	$Na_2B_4O_7$	500.0	None	3.0-9.0
Bromide	$NaBr$	500.0	None	2.0-9.0
Carbonate	Na_2CO_3	500.0	None	3.0-9.0
Chlorate	$KClO_3$	500.0	None	2.5-9.0
Chloride	$NaCl$	1000.0	None	2.0-9.0
Citrate	$C_6H_8O_7$	500.0	None	2.0-9.0
Cyanide	KCN	10.0	2.0	2.0-9.0
Dichromate	$K_2Cr_2O_7$	100.0	Change hue	.....
		20.0	None	2.5-9.0
Fluoride	NaF	500.0	1.6	4.0-9.0
Iodide	KI	500.0	None	2.0-9.0
Nitrate	KNO_3	500.0	None	2.0-9.0
Nitrite	KNO_2	500.0	None	2.5-9.0
Oxalate	$(NH_4)_2C_2O_4$	500.0	None	6.0-9.0
Perchlorate	$KClO_4$	100.0	1.2	2.0-9.0
Phosphate (as P_2O_5)	$(NH_4)_2HPO_4$	20.0	1.4	2.0-9.0
Pyrophosphate	$Na_4P_2O_7$	50.0	1.0	6.0-9.0
		20.0	1.0	5.5-9.0
Silicate	Na_2SiO_3	100.0	None	2.0-4.5
		50.0	None	2.0-5.0
Sulfate	$(NH_4)_2SO_4$	500.0	None	2.0-9.0
Sulfite	Na_2SO_3	500.0	None	2.0-9.0
Tartrate	$(NH_4)_2C_4H_4O_6$	500.0	None	3.0-9.0
Thiocyanate	$KCNS$	500.0	None	2.0-9.0
Thiosulfate	$Na_2S_2O_3$	500.0	None[a]	3.0-9.0

[a] Transmittancy determined within 10 minutes after color developed. Iron reduced with hydroxylamine hydrochloride in all tests.

COPPER

Copper was determined electrolytically [9]. The diethyldithiocarbamate method is given in "Standard Methods for the Examination of Water and Sewage." This reagent is not specific and it was not satisfactory for sewage or industrial wastes. Our difficulty may have been due to the fact that most of our sewage contained iron; and river water, manganese as well. At the time the diethyldithiocarbamate method was used, no modification was suggested to take care of the interference due to iron. (Only the Eighth Edition of "Standard Methods" was available.) In the Ninth Edition, [6] the interference due to iron is taken care of by the use of c-hydroxyphenylglycine and bipyridine solutions. There was no opportunity to try this modification due to the pressure of other work.

Although the electrodeposition of copper is described in almost all quantitative analytical texts, the preparation of the sample prior to electrodeposition is important and the set-up that was made for the deposition was somewhat modified so that a complete description of the method is given in detail.

The sample was prepared by concentrating 1 to 2 liters to 250 ml. unless the sample was known to contain 10 mg. or more of copper. Less than 1 mg. of copper in 250 ml. of a sample will not give accurate results.

Procedure for Copper

1. Add 20 ml. concentrated sulfuric acid, fume in a hood, until the white fumes of sulfur trioxide are given off. This removes any hydrochloric acid present. If organic matter is present proceed as above, but continue heating until digestion is completed, as evidenced by the clearing of the solution.
2. Allow the solution to cool, then make alkaline with concentrated ammonium hydroxide. Add the ammonium hydroxide slowly with mixing, to avoid spattering and loss of sample.
3. Filter through Whatman No. 2 filter paper and was precipitate with 6N ammonium hydroxide until the washings are colorless. Add all washings to original filtrate.
4. Save the precipitate for other desired metal analyses.
5. Neutralize the filtrate with con-

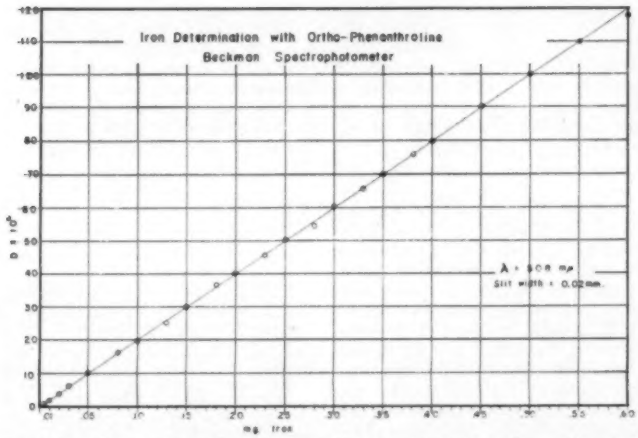


Fig. 1—Iron Determination with Ortho-Phenanthroline using Beckman Spectrophotometer

centrated nitric acid, then add 5 ml. of concentrated nitric acid and 10 ml. of concentrated sulfuric acid.

6. Start the electrolysis. (See method of electrodeposition.) Add a small piece of urea, approximately 0.5 gram. Use 4 to 6 amps., for one hour, or until all the copper is out of solution. (Test for complete deposition.)
7. Lower beaker from electrodes, washing electrodes with distilled water.
   CAUTION: Be certain current remains on as long as electrodes remain in the solution.
8. Dip cathode in acetone and place in drying oven 15 minutes.
9. Cool cathode in dessicator, weigh rapidly.
10. Clean cathode in 6N nitric acid, wash, dip in acetone and dry in 103°C oven.
11. Cool in dessicator and weigh.

Calculations

Weight of cathode in step No. 9 minus Wt. of cathode in step No. 11 = Wt. of copper in sample.

$$\frac{\text{Wt. of Cu (mg.)} \times 1000}{\text{Ml. of sample}} = \text{ppm. Cu.}$$

Method of Electrodeposition

Equipment

12 volt storage battery
D.C. voltmeter, 0-25 volts
D.C. ammeter, 0-10 amps.
Wires, large and small alligator type battery clips.
Platinum electrodes
  Spiral anode and gauze type cathode
Berzelius beakers, 300 ml.
Source of compressed air

The apparatus consisted of a back panel board, beneath which space was provided for running from one to six depositions simultaneously. Wiring of all cells was in parallel, so that any one could be removed without breaking the circuit. The line for the cathode was mounted directly to the underside of the panel board. Connections to the cathods were made by drilling a small hole, slightly larger than the diameter of the cathode rod (about 2 mm.) into an aluminum collar. A set screw was used to take up the slack. The other end of the collar made contact by pressure against the underside of the panel board, being held securely by a screw and thread arrangement through the board. The anode connections were made by individual small battery clips of the alligator type, the other end of the clips going to the common anode line by flexible connectors. The common anode line was suspended from the underside of the panel board. Both lines ran to a connecting plate at one end of the apparatus, where the battery leads were brought.

The battery was a 12 volt, 6 cell, automobile type of "A" battery. The voltmeter mounted on the back of the panel board gave the voltage drop in the circuit, the ammeter, being similarly mounted, giving the amperage of the circuit. (A diagram of the apparatus is shown in Fig. 2.) In

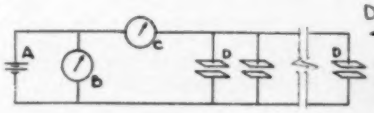


Diagram A - Wiring Diagram for Electrodeposition

'A' - Storage battery, 12 volt.
'B' - DC Voltmeter, 0-25 volt.
'C' - DC Ammeter, 0-10 amps.
'D' - Electrolytic Cells (Up to 6)

Diagram B - Electrolytic Cell with Electrodes

'A' Liquid level.
'B' - Glass insulators (3).
'C' - Anode, spiral, platinum, overall height: 12.5 mm. spiral: 5mm. × 2.75 m.
'D' - Cathode, gauze, platinum, overall height: 15 mm. gauze: 5mm × 2.75mm.
'E' - Air tube, glass, 6mm OD.
'F' - Hose, rubber, 8mm OD.
'G' - Beaker, Berzelius type, 300 ml.
'H' - Battery clip, small, Alligator type
'J' - Mounted collar.
'K' - Clamp, thermometer type
'L' - Support plate
'M' - Ring stand.

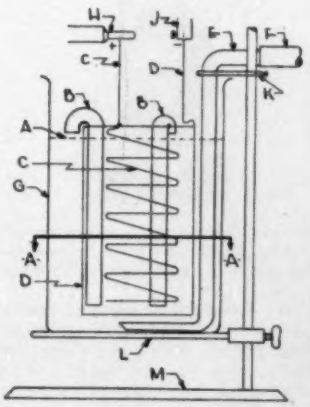


Diagram C - Electrode Assembly Showing Insulators in Position (Section A-A)

'A' - Cathode, gauze, platinum.
'B' - Glass Insulators (3)
'C' - Anode, spiral, platinum.
'D' - Beaker

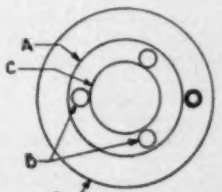


Fig. 2—Diagrams for Electrodeposition Apparatus

operation, it was found unnecessary to introduce any addition form of resistance, other than that of the entire circuit. By varying the number of cells of the battery used the desired amperage was obtained. For this set-up, using 6 electrolytic cells simultaneously, it was found that 2 cells (4 V), gave 4 to 6 amps. The number of cells needed will vary with each set-up, since many factors determine the total resistance, e.g., type of wire used, distance between anode and cathode, etc. (See Diagram A, Fig. 2.)

Since only the cathode is supported, a method had to be devised to support the anode, and yet maintain electrical insulation. This was achieved by the use of three glass rods, for each set-up. (See Diagram C, Fig. 2.) Each rod was bent at one end so as to hook on to the upper rim of the gauze cathode. The diameter of the rods was chosen so that a snug fit was secured, which held the anode centered, in position, and also eliminated any possible short circuiting of the electrodes. (PRECAUTION: Care must be absolutely taken to prevent the electrodes from coming in contact or they will be ruined.) These rods were placed about 120° apart. Contact to the anode was made by means of the small battery clips, while the cathode made contact through the collar fastening.

Stirring of the solution was obtained by blowing air through the solution. The air was introduced at the bottom of the beaker by means of glass tubing. These tubes were bent to follow the beaker bottom for about ½ inch, and bent at the other end to fit over the rim of the beaker. They were positioned by thermometer clamps, mounted on the ring stand support. The air to each beaker was controlled by individual screw type clamps, placed on the rubber hose connectors.

The beakers were raised or lowered from position, after the electrodes were fastened, by the support plates. The current was turned on by attaching the clips to the battery.

Diagram B (Fig. 2) shows all the elements of a cell in position.

It is, of course, possible to buy apparatus already set-up for electrolytic determination of copper but the set-up used in these studies was not only less expensive but was readily obtainable at the time.

References

1. Pearse, Langdon *et al.* Committee Report on the Operation and Control of Activated Sludge Sewage Treatment Works. *Sew. Wks. J.* 14:46 (Jan., 1942).
2. Placak, O. R., Ruchhoft, C. C. and Snapp, R. G. "The Effect of Copper and Chromate Ions on the B.O.D. of Sewage Dilutions." Presented before the Division of Water, Sewage and Sanitation Chemistry of the American Chemical Society, April 19, 1948.
3. Swope, H. Gladys, Gearing, Anne and O'Callaghan, Mary Louise. "The B.O.D. of Vanadium and Its Effect on the B.O.D. of Sewage." *Ibid.*
4. Fortune, W. B. with Mellon, M. G. "Determination of Iron with o-Phenanthroline." *Ind. and Eng. Chem. Anal. Ed.* 10: 62-64 (Feb., 1948).
5. Pierce, W. C. and Haenisch, Edward L. "Quantitative Analysis," pp. 380-384, 2nd Ed. (1940). John Wiley and Sons.
6. "Standard Methods for the Examination of Water and Sewage," pp. 47-48, 9th Ed. 1946). American Public Health Assn.

S. T. Barker Asst. Dir. N. Y. State Bur. of Envir. Health

Stanley T. Barker has been appointed by the N.Y. State Health Commissioner to the post of Assistant

Director, Bureau of Environmental Health. In this capacity he will be assistant to Earl Devendorf, Director of the Bureau.

Mr. Barker joined the engineering staff of the Department of Health in 1936 and has served in various capacities since, his most recent assignment having been Chief of the Sewage and Wastes Section.

A graduate of Harvard University, Mr. Barker has seen service with the Sanitary District of Chicago, the Illinois State Dept. of Health and several consulting engineering and contracting firms.

Mr. Barker is a veteran of both world wars and during World War II rose from the rank of Lt. Comdr. to Captain in the Navy Civil Engineer Corps (Reserve). During the last half of his six year service during the war, he was a member of the U.S. Naval Aviation Mission to Peru, So. Amer., and his assignment was to the position of Director of Construction for the Peruvian Air Force in which he held the temporary rank of Colonel.

H. S. Morse Retires from Indianapolis Water Co.

Howard S. Morse, Executive Vice Pres., Indianapolis Water Co., retired on Dec. 31, after nearly a quarter of a century of management of the utility. He began as manager in May 1925, became general manager in 1938 and executive vice president in 1949.

During his tenure at the helm of the company, the population increased from 247,600 to 470,000. Customers in 1925 numbered 65,000 and meters a mere 20,078. In 1949 both customers and meters exceeded 100,000. Water usage in this past quarter century increased from 12 billion to 19 billion gallons yearly, and the distribution system grew from 549 miles to 866 miles. Plant facilities were increased also to supply the growing needs of the community.

Mr. Morse has been both a national and a state officer in the Amer. Water Works Assn. and the Amer. Soc. of Civ. Engrs. and served the State as a member of the Indiana Flood Control and Water Resources Committee.

Mr. Morse will maintain his association with the Indianapolis Water Co. as a member of the Board of Directors. Active management of the company will be taken over by Alfred O. Norris, formerly manager and vice-president of the Birmingham, Ala. Water Works. Mr. Norris was elected vice-president and general manager of the Indianapolis Water Co. last April.

"... and this is our new Sewage Disposal Plant."

22nd N.Y. STATE SEWAGE WORKS ASSN. MEETING

Changes Name to N.Y. Sewage and Industrial Wastes Assn.

AT the 22nd annual meeting of the N.Y. State Sew. Wks. Assn., held in New York at the Statler Hotel on Jan. 20-21, it was announced that the membership had

Presidents

Incoming	Outgoing
J. W. Johnson	*Paul Bardet*
Supt.	*Supt.*
Sew. Treat. Wks.	*26th Ward Works*
Buffalo, N.Y.	*New York City*

voted to change the name of the organization. Reason for the change was to more fully reflect the fact that this organization serves the needs of the industrial wastes engineers as well as municipal sewage works. The new name is New York Sewage and Industrial Wastes Assn.

More than 250 persons attended the annual luncheon and were welcomed by the Hon. Frederick H. Zurmuhlen, Comm. of Pub. Wks., New York City. Mr. Zurmuhlen paid high tribute to the engineers and operators who design, maintain, and operate the sewage treatment facilities of New York City.

Awards

At the luncheon, it was announced that the Association had nominated **John Chester Brigham** to receive the Federation's Arthur S. Bedell Award in 1950 for his long time service to the N.Y. Association as Assistant Secretary and Treasurer.

The Past President's Key and Certificate were presented by incoming president, John W. Johnson to **Paul E. Bardet,** retiring president, and Supt. 26th Ward Sewage Works, N.Y.C.

The presentation of the Kenneth Allen Memorial Award for a research paper of outstanding merit, was made by Uhl T. Mann, Chairman of the Memorial Awards Committee, to **Daniel Okun,** now with Malcolm Pirnie Engineers, for his paper on Bio-precipitation published in Sewage Works Journal.

Officers

At the annual meeting of the Executive Committee of the N.Y.S.-S.W.A. new officers were elected to serve for the ensuing year.

President
John W. Johnson, Supt.
Sewage Treatment Works
Buffalo Sewer Authority
Buffalo, N.Y.

Vice President
John M. MacCrea
Manufacturers Agent
Syracuse, N.Y.

Secretary
Ralph C. Sweeney
District Engineer
State Dept. of Health
Rochester, N.Y.

Treasurer
J. C. Brigham
Sr. San. Engineer
State Dept. of Health
Albany, N.Y.

Three new members were elected to the Executive Committee as follows: Francis J. Cramer, Rochester, N.Y. (Genesee Valley Section); Milton T. Hill, Montgomery, N.Y. (Lower Hudson Section); and W. R. Schreiner, Glens Falls, N.Y. (Capital District Section).

A. S. Bedell Award
J. C. Brigham
Sr. San. Engr.
St. H'lth Dept.
Albany, N.Y.

Sewage Absorption Fields

"RATIONAL DESIGN CRITERIA FOR SEWAGE ABSORPTION FIELDS" by John E. Kiker, Jr., Prof. of Pub. Health Engr., University of Florida, Gainesville, Fla.

Prof. Kiker reviewed the history of the soil leaching test and explained that all of his recent work had been published as a part of Bull. 23 of the Florida Experiment Station. From these studies which were

Vice-Pres.	Secretary
J. M. MacCrea	*R. C. Sweeney*
Mfrs. Agent	*Dist. Engr.*
Syracuse	*St. H'lth Dept.*
N.Y.	*Rochester, N.Y.*

made on a variety of soil conditions it was determined that soil percolation could be determined from an empirical formula which he developed.

These data and formulas are useful tools in developing areas where sewage disposal must be by leaching because of the absence of sewers and sewage plants.

"DISCUSSION" by T. W. Bendixon, Soil Scientist, Environmental Health Center, U.S. Pub. Health Service, Cincinnati, Ohio. Mr. Bendixon said that Prof. Kiker's formula allowed for more flexibility than previous formulas. He and his associates have been working on improvements to the test. He has noted that in conducting the test, it must be carried on until the absorbiton rate is constant. This may take a long time.

Water Pollution Control in N.Y.

"RESUME OF PROGRESS AND ACTIVITIES UNDER THE N.Y. STATE WATER POLLUTION CONTROL ACT" by A. F. Dappert, Exec. Secy., Water Pollution Control Bd., Albany, N.Y.

Mr. Dappert reviewed the creation of the Water Pollution Control Board in New York State, and spoke of the problems which had confronted its operation to date. These problems include budgets and the delays of organization. The permanent staff consists of an Exec. Secy. and a principal stenographer, plus the full time services of the Stream Pollution Control Section of the Dept. of Health. In addition the Board may call on the technical

personnel of the Health Dept. for any particular services desired.

The Board has two consultants, Assemblyman Harol Ostertag, on legislative matters, and Martin Hilfinger, Pres. of Assoc. Industries of N.Y. on industrial matters.

The Board has two specific jobs to accomplish. The first is to develop a classification for all waters of the state and water standards under these classifications. The second objective is to make a study of all waters within the state, a work that will take at least ten years.

The law says that the board must classify the waters of the state and Mr. Dappert and his associates have now developed tentative classifications for discussion. These classifications contain seven classes for fresh waters, four classes for tidal waters, and two classes for ground waters. These tentative proposals have been released to a number of interested technical persons for constructive criticism but are not available for publication.

When these tentative proposals have had critical study and suggestions by as many persons as possible, they will be presented to the Board and then will come before public hearings throughout the state, after which the final classifications will be adopted by the Board.

"Discussion" by Charles C. Agar, Chief, Water Poualtion Control Section, New York State Health Dept., Albany, N.Y.

Mr. Agar reviewed the work of his unit on the Roundout-Walkill Drainage Basin, and stated that the survey of watersheds in the state will be made on a priority basis.

There are two purposes of the Act creating the Board, one to prevent new pollution, and another to abate present pollution.

In making a survey, there are 14 things that will be done in developing information on any watershed or part thereof. These findings will be presented as a final report to the Board for its decision following which a public hearing will be held. Use but not abuse of the waters of New York will be tolerated.

(The following papers were reported by Harry A. Faber,* Editorial Associate, Water & Sewage Works).

Pincus Guest Speaker

"World Health Organization and Sanitary Engineering" was the topic of the luncheon guest speaker, Sol Pincus, Consulting Engineer; recently Chief, Environmental Sanitation Section, WHO.

Mr. Pincus described the World Health Organization as a creation of the United Nations, but as an organization which functions independently. Since its formation in 1947, WHO has grown to its present membership of 60 participating nations. In its program, sanitation projects are of primary importance and now have two of the top six priorities.

Sanitary engineering specialists are utilized for demonstrations and for advice in specific problems; the training of additional personnel to

*Research Chemist, The Chlorine Institute, New York City.

develop international standards of public health is now under way. Present projects are devoted to supplying assistance in financing improvements in sanitation, and to investigation of programs which member nations can utilize for furthering their own sanitary improvements

The fact that more than three-fourths of the world's population drinks unsafe water and lives under unsanitary conditions indicates the need for the WHO program. Except in the Western hemisphere, there is a pitifully small number of trained specialists, but the research and planning under development hold great hope for the future.

INDUSTRIAL WASTE PANEL

The major feature of the afternoon session was a panel discussion of "Industrial Waste Disposal in Relation to Municipal Sewage Treatment." Under the leadership of George E. Symons, Associate Editor, *Water and Sewage Works*, a group of oustanding specialists was collected for this part of the program. Dr. Symons introduced as participants:

L. A. Danse, Supervisor, Materials and Processes, General Motors Corp., and Member, Federal Water Pollution Control Advisory Board.

R. J. Dougherty, Sanitary Engineer, H. J. Heinz Co., Philadelphia, Pa.

H. W. Gehm, Technical Advisor, National Council for Stream Improvement, New York City.

John C. Geyer, Professor of Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

C. Fred Gurnham, Chairman, Dept. of Chemical Engineering, Tufts College, Medford, Mass.

H. G. Harding, Sanitary Engineer, National Dairy Research Laboratories, Inc., Oakdale, L. I., N. Y.

R. W. Hess, Head, Pollution Research and Operating Improvements, National Aniline Div., Allied Chemical and Dye Corp., Buffalo, N. Y.

M. H. Klegerman, Cons. Engr., Senior Member, Alexander Potter Associates, New York City.

Joseph A. Lieberman, Asst. Sanitary Engineer, Atomic Energy Commission, Washington, D. C.

W. H. Wisely, Executive Secretary, Federation of Sewage Works Assns., Champaign, Ill.

Pollution Control Advisory Board

Dr. Symons opened the discussion by commenting on the general and specific nature of questions which arise when consideration is given to the disposal of industrial wastes in municipal sewage treatment plants. Among such questions are: the treatability of wastes; problems of preliminary treatment; the effect of industrial wastes on processes for handling domestic wastes; the attitude of public officials; and the allocation of costs between industrial and municipal loadings. He presented L. A. Danse as the first speaker in order to provide an over-all view of the policies and procedures of the Federal Water Pollution Control Advisory Board.

Mr. Danse emphasized, first, that the Board will "rubber-stamp" noth-

ing; it is carefully investigating and forcibly advising, and has the enthusiastic backing of the U. S. Public Health Service. Reports to the Advisory Board from state sanitary engineers show that, in the Ohio River Basin, progress in waste treatment made by municipalities is lagging behind that made by industries.

The Advisory Board has recommended that pollution control measurse be financed on a local basis, and has advised methods by which this may be accomplished. Industry and trade associations have been called upon to cooperate with the Advisory Board; the Public Health Service will work with both in developing uniformity of attitude and results. Some 1300 treatment plants, to cost over 2 billion dollars, are contemplated to fulfill the pollution abatement program. According to Mr. Danse, there is now evidence that—in many instances—municipalities and industries are no longer awaiting Federal aid, but are going ahead on their own initiative.

A. F. Dappert
Exec. Sec'y
N.Y. W'r. Pol. Bd.
Albany
N.Y.

C. C. Agar
Chief
Std. Poll. Sect.
St. H'lth Dept.
Albany, N.Y.

Uhl T. Mann
Supt.
Ley Cr. Plant
Syracuse, N.Y.

R. G. Gould
Director
Div. Sew. Disp.
New York City
N.Y.

Programmers

C. J. Velz
Prof.
Sch. Pub. H'lth
Univ. of Mich.
Ann Arbor, Mich.

W. Donaldson
Chief
Bur. Sew. Des.
New York City
N.Y.

Program Committee

Specific Questions

Following this introductory statement of objectives and progress, Dr. Symons directed some thirty specific questions to panel members for reply. It is impossible to report all of the questions and answers but of particular interest were the following:

Mr. Wisely—Should municipalities adapt ordinance in reference to receiving and treating industrial wastes or should such action be by negotiation?

Yes, such an ordinance is absolutely necessary—but it should be one requiring cooperation between the industry and the municipality, not one setting specific standards of quality.

Dr. Hess—Should municipalities be allowed to make contracts with industry to receive wastes?

Where substantial expenditures are required, then contracts should be entered into—to protect both municipalities and industries, and to protect the streams against both.

Prof. Geyer—Under what conditions should industrial wastes be kept out of municipal sewers because of their effect on the sewer itself?

Industrial wastes may be a problem both because of their effect on sewers and upon the sewage treatment plant. The problem depends upon the volume and characteristics of the wastes; characteristic features include explosive hazards, grease, heavy suspended matter, strong gases, and readily decomposible material.

Prof. Geyer—At what point in volume of discharge does an industrial waste begin to become significant?

Any industrial waste creates a significant problem when the size of the domestic treatment plant is inadequate and when other industrial wastes are excessive.

Mr. Wisely—Should industries be allowed to bear part of the costs of constructing municipal disposal plants?

It should be more significant to state that industry *should* bear a part of the costs of constructing municipal disposal plants if the industry bears an important responsibility, but industry should be given credit for its contributions.

Mr. Wisely—Is it feasible to enact ordinances which set limits on concentrations of industrial wastes discharged into municipal sewer systems?

Yes, it is feasible to set such limits but the ordinance should set a level upon which negotiations are required, below that level the municipality does not need to waste its time and effort.

Prof. Geyer—On what types of treatment plants may industrial wastes have significant effects?

Any type of sewage treatment plant or process may suffer from the discharge of industrial wastes but secondary treatment processes are most likely to be affected.

Mr. Klegerman—What is the function of the Consulting Engineer with respect to the problems of Industrial Waste in relation to municipal sewage treatment.

The professional engineer must investigate all varieties of industrial wastes and his studies must provide the best of recommendations and regulations. These studies, and their technical soundness, are the basis for financing the installation.

Dr. Hess—If industry is charged by formula for waste treatment, should chlorine demand, B.O.D., suspended solids, or other basis of charge be determined at the disposal plant dilution rather than on the undiluted waste?

Investigations show the basic characteristics should be determined on the mixed waste and domestic sewage at the dilution which will obtain at the sewage treatment plant.

Radioactive Wastes

Panel Leader—And now here's a problem that has been worrying a number of sewage plant operators—Atomic Energy Wastes. Reply by Mr. Lieberman.

The Atomic Energy industry is a government monopoly and the Commission is a trustee for the people. The effect of wastes on municipal sewage treatment plants has hardly been investigated, but it is known that biological organisms in secondary plants are very resistant and unlikely to be affected; there is a buildup to a concentration of perhaps 100,000 times the original energy through biological growth. There is no known instance at present of a deleterious effect upon treatment plants from the discharge of wastes which contain isotopes. It is possible that wastes from hospitals

and research uses of these materials may constitute sources of discharge to sewage treatment plants. There are now in existence careful controls which affect distribution of these materials and which protect the competence of the users. Even so it is considered up to the individual states regarding the use of these materials and the concentrations in wastes for plant protection.

plants. He also called attention to in-plant-sanitation as accomplishing considerable reductions (up to 35 per cent) of the B.O.D. There is no formula for allocating costs but he cited instances of negotiation in difference municipalities where such wastes are handled.

Metal Plating Wastes

Dr. Gurnham said that the neu-

Mr. Gould briefly reviewed original plant construction, pointing out that this was based on an excellent plan. The recent changes have been developed to correct an overloaded condition. Studies indicated the best possibilities for improvement existed in the final settling units (32 tanks in 4 batteries). Liquor from the aeration units was discharged to the final settling units at the center and flowed

Geo. E. Symons
Assoc. Ed.
Wat. & Sew. Wks.
New York City
N.Y.

H. W. Gehm
Tech. Dir.
Nat. Council
New York City
N.Y.

Industrial Waste Panel

J. C. Geyer
Prof.
Johns Hopkins
Baltimore
Md.

R. W. Hess
Head
Poll. Res.
Nat. Aniline
Buffalo, N.Y.

J. A. Lieberman
Asst. San. Engr.
At. Energy Comm.
Washington
D.C.

W. H. Wisely
Exec. Secy.
Fed. S.W.A.
Champaign
Ill.

(Ed. Note: Photographs not available for other members of panel: L. A. Danse, Gen. Motors Corp., Detroit; R. J. Dougherty, H. J. Heinz Co., Phila., Pa.; C. F. Gurnham, Head Chem. Engr., Tufts College, Medford Mass.; H. G. Harding, Nat. Dairy Labs., Oakdale, L.I.; and M. H. Klegerman, Cons. Engr., New York, N.Y.)

Milk Waste

Mr. Harding discussed the sources of milk wastes, mentioning cooling water, spoiled and waste dairy products, drip leaks and wash waters. He noted that the strength of these wastes (commonly 500 to 1300 ppm. B.O.D.) is much stronger than that of domestic sewage. When there is a disproportionate load of these wastes in the treatment plant, an increased dilution may be essential to prevent septic conditions. Pretreatment methods found suitable are:

1. The elimination of as much volume and strength as is possible by good housekeeping within the plant.
2. The discharge should be allocated over a 24-hour period.

Complete secondary treatment can seldom be justified when the municipality utilizes biological treatment in the receiving plant.

Boxboard Wastes

Dr. Gehm considered only white water from boxboard manufacture could so far be handled satisfactorily in municipality sewage treatment plants. The white water from paper machines generally has no effect, but a serious question of plant capacity must be considered.

Food Processing Waste

Mr. Dougherty described the treatment of food processing wastes in municipal sewage treatment

tralizing of free acid and precipitation of iron are the minimum essential treatmetn steps for handling acid wastes from metal pickling and plating. This treatment does not affect cyanides, chromates, etc. Studies have been made in the Alleghany County investigations of the concentrations of metallic constituents which can be tolerated.

Municipal-Industrial Problem

As an example of the problems met in a municipality where a variety of industrial wastes abound, Mr. Klegerman cited a specific city in New Jersey. The industrial wastes involved were outlined, the proposed method of treating the mixed wastes was discussed and the method of financing and sewer rental formulas were presented by Mr. Klegerman.

Mr. Danse summed up briefly for the panel.

Wards Island Improvements

"Recent Structural Changes in the Wards Island Plant for Increasing Capacity and Improving Operation" by Richard H. Gould, Director, Division of Sewage Disposal, New York City Dept. of Public Works.

Mr. Gould described these changes as necessitated by the increased sewage flow from growing population and rising water consumption. His paper was presented to familiarize members with details to be shown on the inspection trip planned for the following day.

to effluent weirs at each end of the tank. Rising currents were set up by the effluent discharge and carried a high solids concentration.

In the new construction, an aerated distribution channel is employed to convey liquor to a new sludge sump at the center of each settling unit. Through this improvement very little sludge has been revealed by dye studies which show the dye to appear in the collected sludge within 15 minutes. There are 66 tide gates at Wards Island; these are required because sewage is taken from interceptors below tide level. The quality of effluent (chloride content variation of as much as 300 ppm.) is affected only at the end of the settling units.

The second important change made is the incorporation of facilities for step-aeration in the aeration units. This change is expected to increase the former plant capacity of 180 mgd. to 240 mgd. Mr. Gould noted the cost of revisions to total $394,000 (approximately two-thirds for changes in final tanks, and one-third for step-aeration facilities), and stated the increase in plant capacity to more than justify this cost.

The afternoon session was completed with a social hour through the courtesy of the Water and Sewage Works Manufacturers Assn. Inc.

Inspection Trip

An inspection was made on Saturday morning to view the recent structural changes at Wards Island Sewage Treatment Plant.

Joseph W. Ellms Dies in 83rd Year

Noted as Water Purification Leader

Joseph W. Ellms, recently retired Commissioner of Sewage Disposal at Cleveland, Ohio, died in his 83rd year as the result of a heart ailment on February 7, 1950.

Joseph Wilton Ellms
(1867-1950)

Born Oct. 4, 1867, in Ayer, Mass., a graduate of Mass. Inst. of Technology (1893), Asst. Chemist in the Lawrence Expt. Sta. of the Mass. Board of Health (1893-'96), Mr. Ellms went to Louisville, Ky., with a group of young engineers soon to become leaders in water purification and sewage disposal, to participate in the now famous tests of high-rate mechanical sand filters, which were soon to supplant slow-sand filtration in America. In this group with Mr. Ellms were the late Robert Spurr Weston, George A. Johnson and George W. Fuller, all four rising to the top of the sanitary engineering profession.

Mr. Ellms became much in demand as an expert in the new methods of water purification, and was called to Cincinnati, Ohio (1898) to participate in the design and construction of the new Cincinnati Filtration Plant, and to remain on as Chemist in Charge of the plant. During Mr. Ellms, tenure at Cincinnati a number of improvements in rapid-sand filtration were originated, the outstanding development being the new high-velocity method of filter washing.

In 1918 Mr. Ellms was called by Cleveland, Ohio, to put the new Cleveland Filtration Plant into service. From 1918 to 1937 he served Cleveland in various water supply positions, his last position, before being appointed Commissioner of Sewage Disposal (1937), being Engineer of Water Purification and Sewage Disposal. During his service he took part in the design and operation of the new Baldwin Filtration Plant of Cleveland. It was in this connection that he applied the economical hydraulic-jump in the flash mixing of chemicals with the raw Lake Erie water. In recognition of this development the City of Cleveland had a bronze plaque cast in his honor and placed in the Baldwin plant. During Mr. Ellms' service in Cleveland he served as advisor and consultant on a number of important water and sewage plants as well as the three sewage treatment plants of Cleveland. In 1937 he transferred completely to sewage disposal in Cleveland and served as Sanitary Engineer and later Commissioner of Sewage Disposal until his retirement January 1, 1950. During this period he served as expert witness in Court cases of considerable importance, including that of lake water diversion by Chicago.

Mr. Ellms was a member of the original committee which developed "Standard Methods of Water Analysis" in 1905. He was the first chairman (1921) of the Ohio Conference on Water Purification, which pioneered in the advancement of knowledge of water purification. He was an early chairman of the Water Purification Div. of the Am. Water Works Assn. and served as Chairman of the "Committee on Water Treatment Plant Design" in the Am. Soc. of Civil Engrs., for which leadership he received the Rudolf Hering Medal in 1940. In 1942 the Case Inst. of Technology conferred on him the honorary degree, Doctor of Sanitary Engineering.

Mr. Ellms contributed many articles to the technical journals and was author of the universally accepted textbook "Water Purification" published by the McGraw-Hill Co.

Joseph Wilton Ellms was the last survivor of the group of brilliant young pioneering chemists and engineers who participated in the now famous Louisville Experiments, which resulted in the swing from the old slow-sand method of water filtration to the high-rate mechanical filters of today. May his memory live on with that of his co-workers—Robert Spurr Weston, George A. Johnson and George W. Fuller.

Water Pollution Abatement Manual

The Manufacturing Chemists' Assn. has issued its Manual Sheet W-2—Water Pollution Abatement Manual for Insoluble and Undissolved Substances.

The bulletin contains seven sections on the following topics: Effect on Receiving Waters, Permissible Concentrations, Removal of Solids from Wastes, Sludge Digestion, Sludge Dewatering, Sludge Disposal, and Equipment Sources.

The section on Removal of Solids from Wastes discusses Screening, Disposal of Screenings, Sedimentation and Clarification, Lagoons, Detritus Tanks, Sedimentation Tanks, Flotation, and Filtering.

All persons interested in industrial waste treatment will find this bulletin of interest. Priced at 20 cents each, copies may be obtained by writing to the Manufacturing Chemists' Assn., 246 Woodward Bldg., Washington 5, D.C.

How to Clean a Hardened Paint Brush*

Many years ago an article by this writer was published in which it was suggested that stiff and hard paint brushes be "hammered" with a hammer, being careful not to ruin the bristles. That treatment is rather severe, especially if the brush is an expensive one. But owners of expensive brushes are not in the habit of allowing them to become hard. Recently this question came in: "How about nylon brushes?" So, the writer did some investigating. He wrote to all of the leading manufacturers of paint brushes, and now he has the following to offer, the 1, 2, 3, etc., being suggestions by various manufacturers of brushes:

Nylon brushes: (1) Soak for 4 or 5 hours in sodium-phosphate. This will tend to loosen the hardened paint. Then wash the brush in hot soap and water and allow to dry. (2) There are several commercial cleaners available on the market, some of which you will find satisfactory for this work. (3) Soak in benzine or turpentine. Work the brush in this solution every so often in order to break up the hardened paint. Wash thoroughly in warm soapy water. Then wash out the soap with clean warm water. Allow to dry.

Bristle brushes: (1) Wash in hot soap and water and scrub on an ordinary scrubbing board. This will take every bit of paint out of the bristles. (2) Use paint and varnish remover, leaving the brush immersed long enough to soften the hard heel. Then soap and water and a hand scrub board. (3) Same as 3 for nylon brushes. (4) Use either a powdered brush cleaner, following directions on the package, or, one of the newer liquid brush cleaners.

*Contributed by W. F. Schaphorst, M.E., Newark, N.J.

INDUSTRIAL-MUNICIPAL COOPERATION

The Foundation of Successful Industrial Waste Disposal via Municipal Sewage Treatment Works*

by

W. H. WISELY
Executive Secretary,
FEDERATION OF SEWAGE WORKS ASSNS.
CHAMPAIGN, ILL.

FORTUNATE indeed is the industry that is located within the sewered area of a municipality operating a sewage collection and treatment system of such type and size that the wastes of the industry are completely absorbed and "lost" in the normal sewage flow. Complexities arise, however, as the industrial wastes assume characteristics of quality or volume that are significant in the operation of the municipal facilities. The need for close technical and administrative collaboration between the industry and municipality becomes increasingly important as the industrial wastes gain in such significance.

Municipal-Industrial Collaboration

In general, the record of municipal-industrial collaboration in the acceptance and handling of trade wastes in public sewage works has not been good. It is pertinent here to list some of the more apparent causes of the breakdown in such relationships:

1. An unreasonable attitude on the part of the municipality with respect to the acceptance of wastes that could be handled satisfactorily, often manifested by construction of municipal sewage works without capacity for wastes from existing industries.

2. Lack of proper preliminary analysis of probable effects of the industrial wastes on the public system.

3. Unrealistic preliminary analysis resulting from incomplete or inaccurate advance information on the character of the industrial operations and wastes.

4. The lack of an agreement or ordinance delineating clearly the characteristics of waste flows that are objectionable to the municipal facilities.

5. Unwillingness on the part of

The Author

operation personnel at the municipal plant to make reasonable adjustments in procedures so as to accommodate certain wastes.

6. Failure of industrial management (a) to exercise necessary control over wastes, (b) to afford conscientious operation of pre-treatment facilities, or (c) to give prompt notice of accidental losses capable of causing upsets or damage to the municipal facilities.

7. Unwillingness on the part of the industry to bear continuing or recurring costs properly chargeable to the handling of its wastes, or to reimburse the municipality for specific damages caused by them.

8. Lack of interest and consideration by both parties for the practical problems of each other, often compounded with mutual suspicion and distrust.

Represented in the above list of contributory causes of faulty industrial-municipal relationships are technical factors, legal factors, financial factors, and what might be termed "human" factors. The latter are by far the most important, and they must be satisfied if all of the others are to be worked out effectively.

The following discussion is confined to the philosophy that must govern the negotiation and administration of industrial waste disposal to public sewage works.

Policy Considerations

The FSWA manual of practice "Municipal Sewer Ordinances," published in 1949, sets forth the following policies under which a municipality should administer the public sewage works:

"1. Privies, septic tanks, cesspools, open sewer outlets or other hazardous and noisome methods of waste disposal shall not be permitted to exist where the public sewer system is available for service.

"2. The public sewage collection and treatment facilities shall be used in a manner reasonably consistent with the purposes and capacities for which such facilities were designed.

"3. No use of the municipal sewage works shall be permitted that may result in physical damage to the structures, interference with operation, or unreasonable maintenance attention and expense."

Further, with respect to the acceptance of industrial wastes into the public sewers, the manual refers with approval to the statement:

"It is unreasonable for a municipality to exclude all industrial wastes from the sewers. It is generally a wise policy to admit to the sewerage system organic wastes requiring treatment, after such preliminary treatment as may be needed to prevent undue burden on sewage treatment, and to exclude wastes which injuriously affect the sewers, pumping stations, or treatment plant structures, or interfere with sewage treatment processes."

Economic Aspects

The economic aspects of the acceptance of industrial wastes for treatment and disposal must also be considered by the municipality. There can certainly be no objection to a general policy in this respect providing for reimbursement of the municipality for plant or system capacity that is used beyond that which the industry might be entitled to use by virtue of its regular tax contribution, in addition to compensation for extraordinary operation costs that

*Presented before the 5th Industrial Waste Conference at Purdue University and here published by permission.

are directly attributable to the handling of the industry's wastes.

The wisely managed and farsighted industry, realizing the advantage it enjoys by having municipal waste disposal facilities available, will adopt a policy providing for full and complete cooperation to the end that the municipal sewage works are not misused. The industry that is permitted to use a public system should appreciate the fact that when the municipality accepts its wastes it is also accepting all responsibility for any stream pollution that may eventually result from them! The industrial concern that must discharge its wastes to a watercourse by way of its own sewers does not enjoy this truly important advantage.

Consequently, industrial management should not decry the action of a municipality in adopting a fair ordinance or set of regulations designed to control the use of the public sewage works so that it will serve best in the common interest of the public. Such ordinances or regulations are, after all, the municipality's insurance against loss or damage that may accrue to the public facilities themselves, or that may be charged against the public in the event of objectionable stream pollution below the municipal sewage treatment plant.

Upon the consummation of a joint municipal-industrial waste disposal agreement, does the responsibility of the industry end at the point of discharge of its wastes to the public sewers? Possibly it does from a strictly legal standpoint, but industrial policy should not be so confined. There have been cases where the municipality has found itself in a bad bargain, with the result that the agreement was voided at the earliest opportunity, leaving the industry to solve its own waste disposal problem as best it could.

The disposal of trade wastes to a public sewer system can be permanently successful only when the best use is made of the municipal sewage works, with due consideration for their capacities, their limitations, and their effectiveness as measured by receiving stream conditions. It is eminently important that industry takes a continuing interest in the operation of the sewage works whenever industrial wastes are significant in their effects. Many problems will thus be avoided; others will be solved more readily because their onset will be observed and understood.

Both the industry and the municipality must enter upon a joint waste disposal arrangement with determination to make it work out to mutual advantage. Such determination will be manifested: first, with considerate appreciation of each party's problems and viewpoint; second, with the intent to make any reasonable concessions necessary to reach the successful solution; and third, with mutual acceptance of responsibilities and the will to meet them honestly and in good faith.

Preliminary Negotiations

The joint municipal-industrial waste disposal arrangement is often doomed to failure because of a bad beginning. It is especially necessary that a good foundation be laid where the trade wastes under consideration will be a consequential component of the load on the municipal facilities.

Individual contacts in these negotiations may or may not be productive. Often a clash of personalities may complicate proceedings. It is the writer's opinion that group conferences are much to be preferred in the initial stages, with management, engineering, and operating phases of both parties being represented. Technical and legal consultants, and representatives of the state water pollution control agency should be brought in if and when the situation warrants.

Obviously, both parties should make a full disclosure of all facts and data pertinent to the proposed waste disposal plan. The industry must supply full information on the characteristics of its wastes, including volumes, flow rates, organic load, toxic constituents, corrosive properties, etc. It must also reveal in a general way its plans for future expansion and new production processes. The municipality would contribute complete data on the sewage works, emphasizing treatment processes used, hydraulic and organic load limits, construction materials, obligations to domestic users and other local industries, interpretation of sewer ordinances, etc.

With dependable basic information at hand, it will be readily possible:

First, to anticipate the probable effects of the wastes, and to decide which flows should be segregated and kept out of the sewers, which flows should be accepted with and without pretreatment, and which flows should be tentatively "tried on for size" until their effects can be determined with assurance.

Second, to investigate economic considerations, and to estimate costs involved to both parties.

Third, to reach policy decisions on acceptance of responsibility, settlement of disputes, etc.

Fourth, to set up a working procedure for operation.

Keeping the Bargain

Once in operation, the joint industrial-municipal waste disposal venture demands the continuing sincere cooperation of both parties in order for it to be successful. The industry should look upon the municipal sewage works as a part of its production operation, equal in importance to the transportation, power, communications, and other services that are used. The municipality should look upon the industry as an asset to the community which is entitled to the best service that can be furnished on a basis that is equitable to other users (and owners) of the system.

The most important point of contact in the relationship, of course, is that between the industrial plant manager and the sewage works superintendent. Where the industrial waste is particularly significant in the sewage flow it is especially desirable that each of these officials be informed regarding the facilities and operations for which the other is responsible. A conference at least once a month, perhaps held alternately at the industry and sewage treatment plant, would help greatly to bring about appreciation and understanding of problems of mutual concern.

A gratifying example of a healthy working arrangement is the situation at Decatur, Ill., where the wastes from a large starch manufacturing plant have been taken successfully for many years by the local sanitary district. Hourly checks are made at the sewage treatment plant on the character of the incoming sewage, and at the first indication of unusual conditions the industry is notified. The starch plant management acts immediately to check the source or cause of possible loss, and to correct it. When accidental loss occurs at the industry, the sewage works is immediately informed as to its nature and magnitude, so that emergency measures may be taken if necessary.

Another good illustration of a sound municipal-industrial relationship is that existing at Marion, Ind., where the municipal sewage works cooperates advantageously with a local milk processing plant in the disposal of whey. This highly concentrated waste cannot ordinarily be taken for treatment with sewage, but a special method of handling was devised at Marion which has appar-

ently proved successful.

In the two cases cited above, the industrial and municipal plant superintendents have complete confidence in each other, and they are both willing to go to considerable extra trouble whenever necessary. It will be noted, incidentally, that the two industries involved are benefiting measurably by the arrangement. At Decatur, the starch plant has an excellent control on process losses, and the milk plant at Marion has found a practical method of disposing of a particularly bothersome waste.

Conclusion

There is, after all, no complicated formula or profound philosophy involved in achieving successful industrial waste disposal by way of municipal sewage works. It must be realized, however, that the human element is equally as important, if not more so, as the enginering, legal, and economic considerations. This fact undoubtedly holds true for any joint effort of two or more parties toward a common objective.

Stated simply, the sound municipal-industrial relationship in waste disposal is founded on an honest, thorough, preliminary appraisal of the wastes to be treated and the facilities available for the purpose, acceptance by the industry of responsibility for the effects of its wastes throughout the sewage collection and treatment system, and the firm determination of both parties to make every reasonable concession that is necessary to the success of the arrangement. Many technical problems that now are common will never arise in the atmosphere of such a relationship, and those that do develop will be far more readily solved.

A POSSIBLE BETTER METHOD OF CHLORINATING WATER LINES

by

NORCLIFFE MEYER
Sanitary Engineer
BARKSDALE FIELD, LA.

Too often, particularly in small municipalities, the question of proper disinfection of new and repaired water mains has been only partially solved by placing loose hypochlorite in each length of pipe as it is laid or by use of inadequately controlled chlorine injection equipment. The deficiencies of placing loose chlorine carrying compounds in the line during installation are familiar to all who have practiced this method, the worst being that that portion of the line near the blowoff point obtains more chlorine than is necessary, and the portion near the point of filling has all the compound washed away. It is known that these powders lose their strength upon exposure.

A Remedy

As a remedy for these defects, the author suggests that powdered chlorine carrying compound be sealed in a water soluble capsule and fastened in place at each joint as the new line is placed or as work progresses on repairs of an old line. As the line is being filled with water the powder remains dry and in place until the line is full. This method has the following advantages:

1. No deterioration of powdered chlorine carrying compound is caused by exposure to air.
2. The compound is not subject to flushing away from the point where it is placed by the water filling the line.
3. Greater control of dosages may be assured than by placement of loose material by hand or dosages of liquid or gaseous chlorine dependent upon estimating line filling rates.
4. Chlorine is liberated in stronger concentrations at the joints, which has always been considered a critical point to sterilize.

Some questions that arise concerning this sterilization method and the best answers available to the author are as follows:

1. What sort of soluble capsule can be used and how can its solution time be controlled so that a line can be completely filled before chlorine is liberated?

   The author has experimented with ordinary gelatin capsules in the sizes used for administering medicants to livestock. "H.T.H." was placed in the capsules and they were then sealed with wax. The "H.T.H." retained its strength for as long as four months. The main requirement is to make certain that there are no leaks which will allow atmospheric moisture to contact the powder. Under controlled conditions of filling and sealing the capsules, it is probable that their useful life could be extended considerably above four months. The useful life of the capsule is not considered of as great importance as the ability to control its solution time. It is known that one method of making gelatin dissolve slower in water is by treating it with formaldehyde. This treatment allowed the time of solubility in quiescent water to be as much as two hours in tests by the author.
2. How can the capsule be fastened in the line?

   This can be accomplished by letting a light string which is attached to the capsule hang out of the pipe joint as the spigot is entered into the bell of the pipe already laid. The yarning of the joint assures that the capsule is secured and that the string leaves no opening in the joint compound for a possible leak.
3. How can it be assured that the released chlorine from the capsule reaches all the pipe in sterilizing concentrations?

   The answer to this question is unknown. It is believed that the released chlorine would be dispersed sufficiently to reach all parts of the pipe in sterilizing concentrations, assuming sufficient dosage, but this has not been proven.

It is hoped that some of the water works people reading this will have the opportunity to test its applicability under simulated field conditions, and having done so will make known the results if they warrant it.

Water Supply Engineering

The new fourth edition of "Water Supply Engineering" by Babbitt and Doland has just been published. Completely revised, this new edition gives a thorough review of up-to-date and accepted practice in the design, construction, operation, and maintenance of water supply systems. Containing nearly 600 pages, and consisting of 31 chapters and two appendixes, this fourth edition features practical applications of fundamental theory and emphasizes functional rather than structural procedure. Among the newer features are chapters on public relations, intakes, aqueducts, and pipe lines. There are chapters on hydraulics, underground flow, well construction, rainfall and runoff, electrical equipment, well pumps as well as quality of water, interpretation of water analysis, sedimentation, coagulation, filtration, softening, and disinfection, among others.

This fourth edition is presented in a new typography and is published on good paper, with easily readable type. Two hundred fifty-eight illustrations add to the usefulness of the book.

Published by McGraw Hill Book Co., Inc., 330 West 42nd St., New York 18, N.Y., "Water Supply Engineering," by H. E. Babbitt and J. J. Doland retails at $6.50 per copy.

A CRITICAL EVALUATION OF ROUTINE SEWAGE ANALYSES

The First of a Series of Articles

by

W. W. ECKENFELDER, JR.
Cons. San. Chemist

JOHN W. HOOD
Superintendent

SEWAGE TREATMENT WORKS
RIDGEWOOD, N.J.

REFERENCE texts generally in use in the sewage field adequately cover the analytical procedures for the various routine analyses. In some of these texts including "Standard Methods" analytical procedures and the determinations, themselves, are also discussed. Interpretation of the data, however, is a matter for the investigator to derive for himself. It is the purpose of the critical evaluation which follows to attempt to present logical interpretations which will be of practical value to the investigator.

The Authors
W. W. Eckenfelder J. W. Hood

Biochemical Oxygen Demand:

The B.O.D. determination has become generally accepted as the principal criterion for sewage and waste disposal plant design and as the standard of plant effluent quality and operational efficiency. The B.O.D. may be defined as that quantity of oxygen required for the stabilization of the decomposable organic matter and oxidizable inorganic matter by aerobic biological action and direct oxygen utilization. The standard 5-day B.O.D. is generally considered to represent 68 per cent of the total carbonaceous oxygen demand, this being based upon a velocity constant of 0.10.[1]

The concept that the 5-day B.O.D. represents 68 percent of the total carbonaceous oxygen demand does not obtain where the oxidation has not been confined to the carbonaceous stage.

The B.O.D. determination is employed to ascertain the strength of a sewage or waste for design purposes, to establish the standard of effluent quality for discharge into the receiving stream and to ascertain the efficiency of a purification process.

It has been found by some investigators that the 5-day B.O.D. of plant effluents contained oxidized forms of nitrogen. Since the attainment of the nitrogenous oxidation stage in the B.O.D. bottle involved accelerated oxygen demand, such B.O.D. values were numerically higher than would have obtained had the biochemical oxidation been confined to the carbonaceous stage.

Work by Ruchhoft et al[2] was undertaken to determine the velocity constants and hence the oxygen demand of only the carbonaceous component by correcting for nitrite and nitrate formation. They found that after correction for nitrification that the velocity constant for carbonaceous oxidation is generally higher in the higher dilutions. Their conclusions indicated that "the value of k in a series of B.O.D. observations is dependent to a large extent upon the period of observation selected for study and to a lesser extent upon the sewage concentration." In order to restrict the determination to carbonaceous oxidation, methods have been devised to eliminate the nitrifying organisms [3].

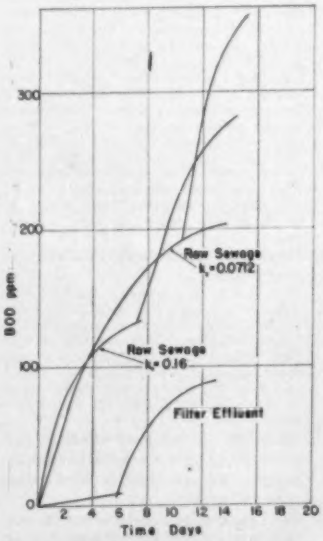


Fig. 1—B.O.D. Oxidation Curves of Raw and Treated Sewage, Ridgewood, N.J.

The limitations of the dilution technique in the determination of B.O.D. are such that generally within the 5-day period only the carbonaceous stage is attained, and little or no nitrogenous oxidation occurs. However, no such limitations are present in the receiving stream because of dilution and accelerated biochemical oxidation. Hence, we find that treatment is continued in the stream. In view of this fact, it is a moot question whether there is any justification for considering only the carbonaceous or first stage oxidation in laboratory analysis and design procedure.

Recent investigations have disclosed wide variations in the B.O.D. velocity constant.[3] Since the B.O.D. structure is based upon an assumed constant of 0.10 any radical departure therefrom involves a numeral variation in the ultimate oxygen demand. Fig. 1 illustrates the variation in the oxygen demand curves of Ridgewood sewage. The velocity constants were computed by Thomas' two-point method. [4]

In view of this fact, there is no justification for the direct comparison of numerical B.O.D.'s derived from various stages of treatment within the same treatment plant.

Variations in B.O.D. determinations have been found by investigators to be induced by variable bacteriological lag periods and organism specificity in the seed material.[5] Certain compounds present in the substrate during the various stages of oxidation may either inhibit or stimulate biological oxidation in the B.O.D. bottle. When present, suspended organic solids will cause great variations in both the calculated 5-day B.O.D. value and in the oxidation velocity constant. In addition to all of these factors which restrict the accuracy of the B.O.D. within 5 to 15 per cent the long incubation period necessarily places severe limitations on the B.O.D. as a practical tool in plant operation.

Relative Stability:

The Relative Stability determination was a precursor to B.O.D. to determine the effectiveness of treatment and the quality of the effluent. This test is still widely and properly employed by many plants where equipment or personnel limitations prevent the determination of B.O.D. The methylene blue will not be reduced while dissolved oxygen is existent in the sample, and hence as long as oxygen is present the sample will remain colored. Methylene Blue is an oxidation-reduction indicator, in which the blue color represents the oxidized form while the decolorized is the reduced form. Therefore, in the Relative Stability Test the time required for decolorization of the methylene blue will be that time necessary to deplete the dissolved oxygen plus the time to reduce the oxidized compounds and the methylene blue to methylene white. In terms of O-R-Potential this value will indicate an E_h potential of —18 millivolts at pH 7.0 for 90 per cent reduction of the methylene blue. This would indicate the departure from an oxidized environment to a reduced environment. Essentially the Relative Stability Test is a colorometric method of determining O-R-Potential. Due to interferences with the dye, or by inhibition of the biological mechanism by toxic agents, this test may not always give reliable results on other than normal domestic sewage. The Relative Stability is computed on the assumption that at 5 days enough oxygen was present to satisfy 68 per cent of the total oxygen demand. Since this in turn is based upon the further assumption that the B.O.D. velocity constant of the waste undergoing treatment is 0.10, these values will be incorrect when the constant departs from the assumed value. Recent investigations [2,4] have revealed wide variations in velocity constants. The validity of the standard B.O.D. test results may be confirmed or denied by concurrent determination of Relative Stability. In view of the foregoing, it is apparent that low Relative Stability should not be found in a sample having low B.O.D. Limitations in the B.O.D. determination are responsible for this apparent contradiction when it exists.

Dissolved Oxygen:

The presence or absence of dissolved oxygen in and through the various units of a treatment process is a factor of prime importance. Fresh aerobic conditions can only be maintained if dissolved oxygen is present from the influent to the effluent. Oxidative processes such as a trickling filter, sand filter and activated sludge require dissolved oxygen to insure oxidative treatment results. Primary sedimentation units receiving oxygen deficient sewage will tend to establish facultative or anaerobic conditions through the detention time therein. Obviously the dissolved oxygen determination is of limited use since the biochemical state of the sewage below zero dissolved oxygen cannot be ascertained. Under such conditions O-R-Potential may be usefully employed as an indicator of the extent to which the reduction is occurring.

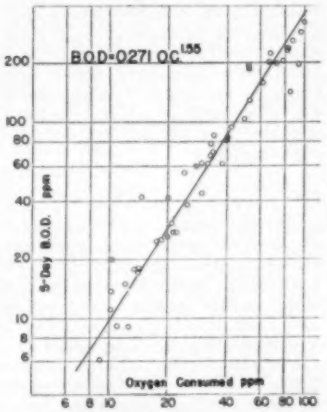


Fig. 2—Relation Between Permanganate Oxygen Consumed and B.O.D. Ridgewood, N.J.

Previous investigators have shown that the descent to zero dissolved oxygen does not necessarily indicate anaerobic conditions. Invariably positive potential values obtain subsequent to the establishment of zero dissolved oxygen in the system. This is due to the presence of oxidized compounds which tend to maintain the subject in positive (oxidation) O-R-Potential values.

The presence of dissolved oxygen in a sample does not necessarily disclose the character or magnitude of pollution. Raw sewage high in B.O.D. may yield several ppm. of dissolved oxygen. Treatment processes have been found operating on a zero dissolved oxygen basis and yet plant records indicate dissolved oxygen present in the effluent at all times. Turbulence above the point of sampling was responsible for the dissolved oxygen determined.

Obviously sampling stations must be carefully chosen if the magnitude of the determinations is to possess any significance. Likewise, the sampling technic and the sampling device employed must be designed to avoid aeration and the artificial introduction of oxygen to the sample. Recent work has shown the interfering value of many chemicals present in wastes [3]. Among these are chlorine, chromium and some organics which exert an iodine demand. Dissolved oxygen determinations yield no quantitative picture of the pollutional load present but merely are indicative of the biological environment existing at the time of sampling. Supervising authorities generally establish minimum dissolved oxygen requirements for treated effluents consonant with the receiving stream conditions.

Chemical Oxygen Demand Tests:

In order to obtain a rapid indication of the oxygen demand of a sewage or waste, several chemical oxidation tests have been used. The most common of these is the permanganate oxygen consumed test as outlined in *"Standard Methods for the Examination of Water and Sewage."* This determination, however, has several limitations imposed by virtue of the fact that many organic compounds are not attacked by permanganate in acid solution. Burtle and Buswell[6] found volatile acids such as acetic, propionic and butyric are not readily oxidized. Nitrogenous compounds are also not attacked by permanganate so that, like the B.O.D., the determination is an indication of the carbonaceous oxygen demand. Rogers[6] indicated that a relation could be established between oxygen consumed and B.O.D. at any partticular plant. In studies made by the authors at Ridgewood, N.J., a relation of the type $y=CX^x$ was found to exist between B.O.D. and oxygen consumed (Fig. 2). Aeration studies on sewage indicated that the absolute values of the permanganate oxygen consumed test were uncertain after attainment of the nitrification stage of oxidation.

Rhame[7] and others have established a chemical oxygen demand test using dichromate as the oxidizing agent. He found that no strict relation could be established between chemical oxidation values and the B.O.D. because cellulose and some other organic compounds will be readily attacked by dichromate but are resistant to biological oxidation in the B.O.D. bottle. Other chemical oxygen demand tests include the use of alkaline potassium permanganate, potassium persulfate and iodic acid.

The conclusions of these investigations indicate that chromic acid and iodic acid oxidations are most effective for complete oxidation. Iodic acid[8] will oxidize all oxidizable

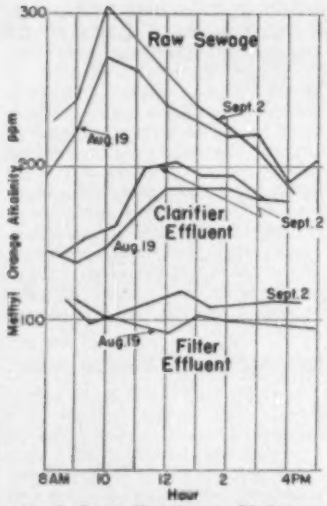


Fig. 3—Hourly Variations in Alkalinity. Ridgewood, N.J.

substances except amino and ammonia nitrogen.

Alkalinity:

The alkalinity determination is common to the water treatment practice. It is not as yet a generally accepted criterion in sewage treatment practice. To date the significance of alkalinity in sewage has been to establish the magnitude of the buffer value.[10,11] In water practice an alkalinity determination discloses the basic mineral constituents. In sewage the alkalinity will in addition disclose the quantities of organic and inorganic compounds present, including ammonium bicarbonate, fatty acids, soaps, phosphates, humic acids, amino acids peptones, etc. Considering normal domestic sewage which would contain approximately 50 per cent carbonaceous material, 37.5 per cent nitrogenous material and 12.5 per cent fats and grease, this being the organic content, the buffer value of the material would be established by these compounds mentioned above. This buffer value will vary as the strength and character of the raw sewage and the degree of treatment (Fig. 3). Decomposition of sewage solids as in separate sludge digestion enhances the alkalinity with the formation of basic compounds. Oxidative treatment reduces the alkalinity by the formation of acidic compounds and the destruction of the alkaline buffer. Hence alkalinity values may be profitably employed to indicate the oxidative effectiveness of the treatment process (Fig. 4).

A substrate deficient in adequate alkalinity or buffer value such as is encountered in predominantly carbonaceous wastes, will render biological processing incomplete due to the formation of acidic products which yield a pH too low for biological activity.

pH

The significance of pH in connection with various biological processes of sewage treatment practice is well recognized. Invariably a pH of 7.0 more or less generally obtains in such processes. Laundry wastes tend to adjust the subject upwards into the normal carbonate and caustic range. Effects of chemical constituents of sewage on pH are shown in Table 1.

Table 1

pH Relationship to Compounds Present in Domestic Sewage

pH	Compounds Present
above 9.3	Caustic
8.3—9.3	Alkaline soaps, carbonates & bicarbonates
7.0—8.3	Ammonium salts, nitrogen derivatives, free carbon dioxide, basic salts of organic acids
6.0—7.0	Carbon compounds, free carbon dioxide, oxidized nitrogen compounds
below 6.0	Acids, free CO_2

Most organisms are found to have optimum pH requirements usually between pH 6.0 and pH 8.0. Extremely high or low pH values will tend to bring any and all biological action to a standstill. No oxidation of sewage or sludge was found by investigators to occur at pH 4.0, very little at pH 12.5. Maximum oxidation occurs in the range pH 6.6-9.0.

We have found that generally in normal domestic sewage a fundamental relation exists between pH, alkalinity and acidity as CO_2 as follows:

$$pH = Ka + \log \frac{Alkalinity}{Acidity} \quad \text{.....Eq. (1)}$$

This is considering the system as based upon Ka of carbonic acid= 6.48. In cases where organic acids are present which change this constant, the relation may be altered. Oxidation depresses the pH by the formation of acidic products and the destruction and neutralization of the alkaline compounds. Hence, in a closed system the depression of pH due to oxidation can be expressed as follows:

$$pH = 6.48 + \log \frac{Alkalinity - Acidic\ Products}{Acidity + Acidic\ Products} \quad \text{.....Eq. (2)}$$

The theoretical relation shown above is altered in normal practice by the loss of gaseous products influenced by turbulence, temperature, aeration, production of alkali carbonates, etc.

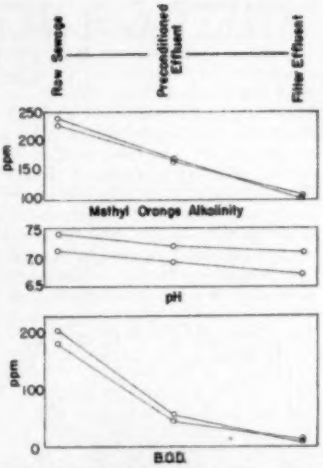


Fig. 4—Unit Efficiencies in Sewage Treatment. Ridgewood, N.J.

Wastes of predominantly carbonaceous character will yield low pH upon fermentation due to the production of carboxylic acids.

O-R-Potential

The application of O-R-Potential (oxidation reduction potential) measurement to biological sewage treatment processes is of comparatively recent date.[8, 9, 10] The importance of this factor in biological environments has long been known and appreciated by investigators in bacteriology, biochemistry and soil microbiology [10] [12] [13] [14].

Oxidation reduction potential is defined as the electrical pressure existing in a liquid as a result of the respective concentration of oxidant and reductant present. This potential, or electromotive force, is measured by means of a vacuum tube potentiometer equipped with an appropriate electrode system.

O-R-Potential measurements are based upon a potential of zero for the hydrogen electrode under 1 atmosphere of hydrogen; pH=O and temperature=zero degrees Centigrade. For practical reasons a calomel half-cell has been substituted for the hydrogen electrode and an appropriate correction applied to derive the E_h values. A correction for temperature is included in the above.

The pH has an important significance in the interpretation of O-R-Potentials in that the magnitude of the potential of a given system will be altered by changes in the pH of that system. In some cases the re-

duced form may be an anion which can accept hydrogen ions and hence become inoperative in contributing to the potential. It is imperative therefore that the pH be reported in conjunction with any given potential.

When applying O-R-Potential measurements to sewage and waste analysis, the E_h obtained not only denotes the classification of the biological environment (Fig. 5) but it also reflects the physio-chemical character of the substrate (reduced and oxidized compounds). E_h may be compared to pH in a buffered system in which the absolute quantities of the various constituents are not revealed but rather yields a qualitative indication of the predominating components. The O-R-Potential will give information as to whether a given substance will oxidize or reduce another substance but not as to how much of the second compound can be oxidized or reduced.

The oxidation-reduction character of an aqueous medium is of vital importance in connection with the growth and activity of organisms.

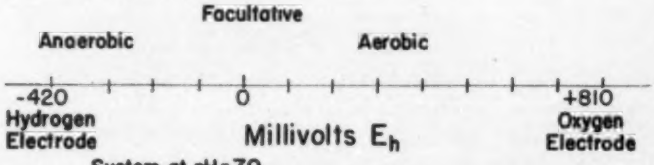


Fig. 5—Biological Classification Chart According to O.R.P.

Obviously the creation and maintenance of favorable O-R-Potential is a prerequisite to successful biological processing. Molecular oxygen dispersed in distilled water tends to produce a potential of high positive value, the E_h of an oxygen electrode being + 810 mv. Hence varying concentrations of dissolved ovygen in organic substrates tends to produce higher potentials. This in turn makes it difficult to evaluate the true O-R-Potential character of the organic substrate.

Evidence to indicate that the poisonous action of O_2 to anaerobes may not be due to direct action of oxygen but rather to the fact that oxygen creates an O-R-Potential in the medium which is unsuitable for the growth of most anaerobes. Anaerobes can grow in low O-R-Potentials even in the presence of free oxygen [20].

The development and interpretations of O-R-Potential have been based upon thermodynamic reversibility. This may be interpreted to mean that the same amount of energy is necessary to reverse a reaction as to produce it. In some cases encountered in sewage and waste investigation, the systems dealt with are irreversible and hence caution must be exercised in the interpretation of the results.

The difference between reversible and irreversible oxidation reduction systems may be due to reaction velocity. Catalysts could convert irreversible systems to reversible ones. In order for a system to be reversible, when the electrons are drawn from the cell by closing the switch to the potentiometer, they will be immediately replenished. In this respect enzymes may be considered to act as catalysts.

In completely reversible systems, small changes in potential either up or down from the equilibrium value will cause measurable oxidation or reduction respectively.

O-R-Potential may be summarized to depend upon (1) the innate tendency of the system to take up or give off electrons, (2) the ratio of the oxidant to the reductant and (3) the hydrogen ion concentration, and (4) to a lesser degree the temperature.

Conclusions:

The foregoing detailed evaluation has focused attention upon certain advantages and limitations of the various tests discussed. Chemical oxygen demand tests offer an advantage over the B.O.D. test due to their rapid determination, but certain compounds may be oxidized chemically and not bio-chemically or vice versa. Likewise, the alkalinity determination offers distinct advantages over the more time consuming B.O.D. test in the evaluation of sewage strength in terms of its buffer, oxidative treatment efficiency and effluent quality.

Where a reasonable doubt exists concerning the validity of effluent B.O.D. results, the Relative Stability test may be employed to confirm or deny these results.

Dissolved oxygen has been shown to play a vital role in the attainment of the required oxidative treatment results and the maintenance of nuisance free aerobic conditions in and around the plant. Intimately related to the presence or absence of dissolved oxygen, the O-R-Potential has been likewise shown to be of great importance in the successful operation of the various biological processes employed in sewage treatment practice.

Acknowledgment:

Grateful acknowledgment is made to Mr. L. L. Langford for his sustained interest and substantial contribution to this work extending over the past ten years.

References

1. Theroux, F. R., Eldridge, E. F. and Mallmann, W. L., "Analysis of Water and Sewage," Third Edition, McGraw Hill Book Co. (1943).
2. Sawyer, C. N. and Bradney, L., "Modernization of the B.O.D. Test for Determining the Efficacy of Sewage Treatment Processes," Sewage Works Journal 18, 113-1120 (1946).
3. Ruchhoft, C. C., Placak, O. R., Kachmar, J. F., Calbert, C. E., "Variations in B.O.D. Velocity Constants of Sewage Dilutions," Ind. and Eng. Chem. 40, 1290-1295 (July 1948).
4. Weston, R. F. and Demann, J. G., Turnbull, H., "The Biochemical Oxygen Demand of Industrial Wastes," The Atlantic Refining Company, Phila., Pa., Unpublished.
5. Burtle, J. and Buswell, A. M., "Oxygen Demand Studies," Sewage Works Journal 9, 224-238 (1937).
6. Rogers, D. P., "Laboratory Guide for Sewage Works Operators," Pennsylvania Sewage Works Association (1946).
7. Rhame, G. S., "Determination of B.O.D. Values by Chemical Oxidation," Water Works and Sewage 94:192-194 (May 1947).
   (Also; Ingols & Murray, "An Oxygen Consumed Test for Sewage," Water & Sewage Wks., March, 1948.)
8. Weston, R. F., "A Chemical Method for the Determination of the Complete Oxygen Demand of Wastes," Atlantic Refining Co., Phila., Pa. (1947).
9. Heukelekian, H., "The Use of the Dilution Method for Determining the Effect of Industrial Wastes on Deoxygenation," Sewage Works Journal No. 19, 612-620 (1947).
10. Ingols, R. S. and Heukelekian, H., "Buffer Values of Sewage During Purification," Ind. and Eng. Chem. 32, 3.
11. Hood, J. W., "Fundamentals of Oxidation Clarification," Sewage Works Journal 18, 656-670 (1946).
12. Rohlich, G. A., Sarles, W. B. and Kessler, L. H., "Oxidation Reduction Potentials in Activated Sludge," a symposium on hydrobiology, University of Wisconsin Press, pp. 288-302 (1941).
13. Hewitt, L. F., "Oxidation Reduction Potentials In Bacteriology and Biochemistry," Fifth Edition, London County Council, London (1946).
14. Clark, W. M., "The Determination of Hydrogen Ions," Third Edition, Williams & Wilkins, Baltimore (1928).
15. Michaelis, L., "Oxidation Reduction Potentials," translated by Louis B. Flexner, J. B. Lippincott, Phila. (1930).
16. Hood, J. W., "Measurement and Control of Sewage Treatment Process Efficiency by Oxidation Reduction Potential," Sewage Works Journal *20*, pp. 640-653 (1948).
17. Porter, J. R., "Bacterial Chemistry and Physiology," John Wiley & Sons (1946).
18. Ruchhoft, C. C., Placak, O. R., and Ettinger, B. M., "Correction of B.O.D. Velocity Constants for Nitrification," Sewage Works Journal *20*, 832-40 (Sept. 1948).
19. Abbott, W. E., "Mechanism of the Activated Sludge Process," Sewage Works Journal *20*, 841-45 (Sept. 1948).
20. Levine, M., "Bacteriological Aspects of Sewage Treatment," Modern Sewage Disposal, Federation of Sewage Works Assn. (1938).
21. Thomas, H. L., "Two-point Method of Fitting B.O.D. Data," Harvard University (1949).

The Editor's Comments

In Defense of the BOD Test

As a consequence of the editorial "BOD vs. COD" in our January issue, two letters in defense of the standard Biochemical Oxygen Demand test have been received. We are surprised, and admittedly disappointed, that amongst the many readers of this magazine only two "defenders" have taken up the gauntlet which was purposely thrown out in the January editorial. We know that many more must have felt an urge to "state their minds" after reading the attack on the BOD test, but so far the challenge has been taken up by only these two. To give their views we have permission to quote from their letters in full.

The first came from T. R. Camp, consulting Engineer of Boston, and formerly Professor of Sanitary Engineering at M.I.T. He has the following to say:

"The editorial, "BOD vs. COD" in your January, 1950, issue seems to me to be very ill advised, and the position you take is a step backwards. It is most desirable to improve chemical methods of measuring oxygen demand of organic wastes in order to facilitate laboratory control, but the chemical tests should supplement the BOD tests and not replace them.

Most of the finely divided and dissolved organic matter in sewage and industrial wastes is of little significance in stream pollution problems unless it is used for food by bacteria and thus results in depletion of the dissolved oxygen in the receiving waters. The process of deoxygenation is a biochemical process which requires the existence and growth of bacteria. The only reliable way to determine the rate and extent of deoxygenation in the laboratory is to reproduce the conditions within the receiving waters under which the process takes place. The original purpose of the BOD test was to do just this. No chemical test can furnish any information about the time rate of biochemical deoxygenation, and the rate is just as important as the amount of deoxygenation.

The technique of making the BOD test as outlined in *Standard Methods* does not reproduce the conditions in the receiving waters, but it comes much closer than any chemical test can. In recent years the test has been widely used for control of operation in treatment plants. Emphasis has been placed on reproducibility of the results in the *Standard Methods* technique, and much of the hue and cry against BOD has arisen from the lack of reproducibility in the standard test. The inconsistency of the results is due in large measure to the fact that the same seeding bacteria are not present in every sample. It is amazing that there is not a greater spread among multiplicate analyses. The fact that there is a variation in the results should not concern us too much, however, since the bacterial flora and the environment undoubtedly vary in the wastes and receiving waters also. We must accept variations in all biological processes.

A chemical oxygen demand test is a valuable tool in the control of operation of treatment plants and in other pollution control problems, but it should not be used unless the results are correlated with BOD tests. An effort should also be made to correlate the results of the laboratory BOD tests with the actual rates of deoxygenation and amounts of deoxygenation in the receiving waters.

Let us not abandon the BOD test. Let us improve the technique and our understanding of the significance of the test."—Thomas R. Camp.

The other letter came from W. D. Hatfield, Supt. of Sewage Treatment at Decatur, Ill. Writing in the capacity of Chairman of the Standard Methods Committee of the Federation of Sewage Works Assns., Dr. Hatfield has the following to say:

"It has been suggested that I should take note of your "BOD vs. COD" editorial which appeared in your January issue and express my views.

The Standard Methods Committee is expecting to include in the next edition one of the newer Dichromate or Iodate methods for chemical oxygen demand (COD) which will replace the old "oxygen consumed from permanganate" method. There is no need for a discussion of "BOD vs. COD." Each method determines certain important values which are not necessarily related, although in certain particular situations a relationship or ratio may be determined so that BOD's can be estimated from COD's.

Such a ratio will vary widely between wastes, pure chemical compounds, effluents and qualities of effluents. For example, the 5 day BOD/Oxygen Consumed ratio on the *raw sewage* at Decatur varies from 2 to 3.5, depending on the ratio of corn products wastes to domestic sewage reaching the plant. For practical purposes, we use 2.5 for estimating the probable BOD so that suitable dilutions for the BOD test may be made. However, in a well oxidized filter effluent the BOD/OC ratio will be 0.5, or less, when the filters are not overloaded, the ratio going up toward 1.0, or higher, as the filters are overloaded and the effluent becomes unstable or septic.

Your editorial is particularly unwise because many industrial chemists do not understand (1) the basic logic on which the BOD determination is built and (2) its application to the type of oxidation taking place in the stream. Many industrialists may mistakenly follow your lead in wanting to use the COD test until they begin to realize that in 99% of the cases the bacterial efficiency in oxidation is such that the total chemical oxidation (L_{COD}) will be 15 to 50% higher than the total biological oxidation (L_{BOD}). Even a simple compound such as glucose is oxidized biologically to only 85-95% of the COD when L is calculated from 10 day curves using the Thomas Slope method. This is likewise true of the pure amino acid, glutamic acid.

Please! Let us not argue the relative merits of these two methods, but rather let us improve the laboratory technic of both methods and try to further the application and interpretation of the results of both methods to the improvement of plant controls and stream studies."—W. D. Hatfield.

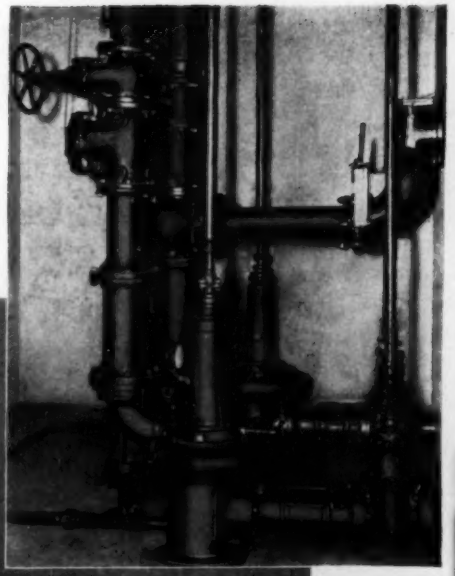
At this juncture we will merely state that none of the points stressed in the letters of Messrs. Hatfield and Camp had been overlooked. It is very nice to think that we are in a measure reproducing or simulating biological and bio-chemical stream conditions in bottles in the laboratory—but, are we? If we can, it should be done; but, attempts to develop a wholly satisfactory, dependable and reproducible BOD test have been in progress now for a number of years; and, just the reading of articles in the current literature by competent investigators (including one by Eckenfelder and Hood in this issue), and yet unpublished studies, only serve to strengthen our opinion that much more needs be done in the direction of developing a really satisfactory measure of putrescible organics in sewages and effluents. Possibly a combination of some form of COD, or Oxidation-Reduction Potential, and BOD test is ultimately to be the only effective means of securing adequate evaluations of purification efficiencies and stream loadings, most particularly those of such heterogeneous and unpredictable nature as the gamut of wastes from industry.

L. H. Enslow

CLOG-PROOF

•

RELIABLE



There's no substitute for The "Chicago"

FLUSH-KLEEN

Sewage Ejector of Proved Performance

"Flush-Kleens" are absolutely clog-proof . . . the impellers handle nothing but strained sewage, minimizing wear and maintaining pump balance. They need no manual attention other than lubrication and inspection. No labor is needed to dis-assemble and clean. Not just another practically non-clog pump—"Flush-Kleens" are *positively* clog-proof.

Look at These Long-established Facts

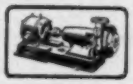
- "Flush-Kleens" are the only absolutely clog-proof sewage pumps; impellers are not required to pass any solids.
- The "Flush-Kleen" will pump anything that will pass through the pipe regardless of type or quantity of material.
- "Flush-Kleen" selection is not limited to a narrow pumping range to prevent dynamic unbalance of the impeller and consequent shaft and bearing failure.
- "Flush-Kleen" versatility and flexibility of operation make selection of the proper unit simple for small stations where accurate capacity and head figures are often not available.

Write for further information and test data on Chicago Pump Company "Flush-Kleen" Sewage Ejectors.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2300 WOLFRAM STREET **CHICAGO 18, ILLINOIS**



Flush Kleen, Scru-Peller, Plunger. Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers, Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

GROUND-KEY WORK
Noted for service since 1890

Glauber Ground Key products are right from the start—right for original low cost, right for years of "just-like-new" operation. This K-1420 curb stop is only one of the more than 1500 waterworks fittings in the proven Glauber line.

Send today for your free copy of the New Glauber Ground-Key and Waterworks fittings catalog. Just drop a card to

GLAUBER BRASS INC.
KINSMAN, OHIO

GLAUBER RED BRASS
GROUND-KEY CURB and CORPORATION STOPS
LEAD GOOSENECKS and WATERWORKS FITTINGS

Now you can machine
TRANSITE PIPE
on the job
with PILOT
MACHINING TOOL

Now a simplex coupling can be used at any point where pipe is cut. Save time in the field and utilize all odd lengths.

Duplicate factory machining in the field or shop on asbestos—cement pressure pipe with this specially engineered hand tool—for all pipe classes through 8" nominal (10" O. D.)

PRESSURE PIPE TOO!

Shipping weight 17 lbs.
List price . . $78.00
freight added

Ask about the new Model 4 Pilot Pipe Cutter. Saves time—money. Easy to use . . . fast—accurate.

at your supplier or write:

PILOT Manufacturing Company
420 MARKET STREET SAN FRANCISCO 11 CALIFORNIA

Distributors wanted. Write for details.

MEETINGS SCHEDULED

MAR. 12-16—COLLEGE STATION, TEXAS (Texas A. & M.)
Texas Water & Sewage Works Association. Sec'y, V. M. Ehlers, State Dept. of Health, Austin, Texas.

MAR. 13-15—MINNEAPOLIS, MINN. (Univ. of Minnesota)
Minnesota Water School. Chairman, A. C. Janzig, Fridley Softening Plant, 43rd & Marshall St. N. E., Minneapolis, Minn.

MAR. 15-17—BATON ROUGE, LA. (Louisiana State Univ.)
Louisiana Conference Water & Sewage (Annual Short Course) Director, John L. Porter, Public Health Engineering, Civil Courts Bldg., New Orleans, La.

MAR. 16—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass.

MAR. 22-24—TRENTON, N.J. (Stacy-Trent Hotel)
New Jersey Sewage Works Association. Sec'y, Michael S. Kachorsky, P. O. Box 283, Manville, N. J.

MAR. 30-31—ROCHESTER, N.Y. (Sheraton Hotel)
New York Section A.W.W.A. (Spring Meeting). Sec'y, R. K. Blanchard, 50 West 50th Street, New York 18, N.Y.

MAR. 30-31—WINCHESTER, VA. (Geo. Washington Hotel)
Virginia Industrial Wastes & Sewage Works Assn. Sec'y, A. H. Paessler, 815 E. Franklin St., Richmond 19, Va.

MAR. 31-APR. 2—SAFFORD, ARIZONA
Arizona Sewage & Water Works Association. Sec'y, Helen Rotthaus, San. Eng. Div., State Capitol, Phoenix, Ariz.

APR. 3-5—NIAGARA FALLS, ONTARIO (General Brock Hotel)
Canadian Section A.W.W.A. Sec'y, Dr. A. E. Berry, Parliament Buildings, Toronto, Ont.

APR. 4-7—ST. LOUIS, MO.
National Association of Corrosion Engineers. Sec'y, A. B. Campbell, 919 Milam Bldg., 803 Texas Ave., Houston, Texas.

APR. 12—SKOWHEGAN, MAINE
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

APR. 12-14—CHICAGO, ILL. (LaSalle Hotel)
Illinois Section A.W.W.A. Sec'y, Carl N. Brown, U. S. Pipe & Foundry Co., 122 So. Michigan Ave., Chicago, Ill.

APR. 17-19—LITTLE ROCK, ARK. (Robinson Memorial Auditorium)
Arkansas Water & Sewage Conference. Sec'y, Prof. Harrison Hale, 118 Chemistry Bldg., Fayetteville, Ark.

APR. 19-21—SALINA, KANSAS (Lamar Hotel)
Kansas Section A.W.W.A. Sec'y, Harry W. Badley, 640 Highland, Salina, Kans.
Kansas Sewage Works Association. Sec'y, Dwight F. Metzler, State Board of Health, Room 2, Marvin Hall, Univ. of Kansas, Lawrence, Kans.

APR. 20—BOSTON, MASS. (Statler Hotel)
New England Water Works Association. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston 8, Mass.

APR. 20—MISSOULA, MONT. (Florence Hotel)
Montana Sewage Works Association. Sec'y, H. B. Foote, State Board of Health, Helena, Mont.

APR. 21-22—MISSOULA, MONT. (Florence Hotel)
Montana Section A.W.W.A. Sec'y, C. W. Brinck, State Board of Health, Helena, Mont.

APR. 26-28—LAFAYETTE, IND. (Purdue University)
Indiana Section A.W.W.A. Sec'y, C. H. Bechert, 445 N. Pennsylvania, Room 200, Indianapolis 4, Ind.

APR. 27-28—CUMBERLAND, MD. (Ft. Cumberland Hotel)
Maryland-Delaware Water and Sewerage Assn. Sec'y, W. McLean Bingley, 2411 No. Charles St., Baltimore, Md.

APR. 28—PATERSON, N.J. (Y.M.C.A.)
North Jersey Water Conference. Sec'y, H. N. Lendall, 26 Clifton Ave., New Brunswick, N. J.

MAY 3-6—LONG BEACH, CALIF. (Lafayette Hotel)
California Sewage Works Association. Sec'y, Lawrence H. Cook, P. O. Box 696, Menlo Park, Calif.

MAY 10—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Sewage Works Association. Sec'y, W. P. Hughes, City Hall, Lewiston, Idaho.

MAY 11-13—TACOMA, WASH. (Winthrop Hotel)
Pacific Northwest Section A.W.W.A. Sec'y, O. P. Newman, Boise Water Corp., Boise, Idaho.

MAY 21-26—PHILADELPHIA, PA.
American Water Works Association (Annual convention). Executive-Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N. Y. (Meetings & Exhibits in the Auditorium.) All reservations will be cleared through the A.W.W.A. Headquarters.

MEETINGS SCHEDULED

MAY 22-24—TRAVERSE CITY, MICH. (Park Place Hotel)
Michigan Sewage Works Association. Sec'y, D. M. Pierce, State Dept. of Health, Lansing 4, Mich.

JUNE 6-8—AUBURN, ALA. (Alabama Polytechnic Institute)
Alabama Water & Sewage Works Association. Sec'y, Alex O. Taylor, Alabama Polytechnic Institute, Auburn, Ala.

JUNE 9-10—INDIANAPOLIS, IND.
Central States Sewage Works Association. Sec'y, Paul W. Reed, 1098 W. Michigan St., Indianapolis 7, Ind.

JUNE 12-13—JAMESTOWN, N. Y. (Hotel Jamestown)
New York Sewage and Industrial Wastes Assn. (Spring Meeting) Sec'y, R. C. Sweeney, 119 E. Main St., Rochester, 4, N. Y.

JUNE 14—KITTERY, MAINE
Maine Water Utilities Assn. Sec'y, Earl A. Tarr, Supt. Water District, Winthrop, Me.

JUNE 28-30—CINCINNATI, OHIO (Gibson Hotel)
Ohio Sewage & Industrial Wastes Treatment Conference. Sec'y, G. A. Hall, 302 Dept. of State Bldg., Columbus, Ohio.

JUNE 29—DOVER, N. J. (Germania Park)
New Jersey Section A.W.W.A. (Clambake and Outing). Inspection Trip, Lock Joint Pipe Co., Wharton, N. J. Sec'y, C. B. Tygert, Box 178, Newark, N. J.

AUG. 9—MT. DESERT ISLAND, ME.
Maine Water Utilities Assn. (Summer Meeting) Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

AUG. 20-22—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Water Works Operators Assn. Sec'y, Prof. Robert E. Stiemke, Dept. of Engineering, State College, Pa.

AUG. 23-25—STATE COLLEGE, PA. (Nittany Lion Inn)
Pennsylvania Sewage & Industrial Wastes Assn. Sec'y. B. S. Bush, Penna. Department Health, Kirby Health Center, Wilkes-Barre, Pa.

SEPT. 7-8—SARANAC LAKE, N. Y. (Saranac Inn)
New York Section A.W.W.A. (Fall Meeting) Sec'y, R. K. Blanchard, 50 West 50th Street, New York, N. Y.

SEPT. 18-21—POLAND SPRING, ME.
New England Water Works Association. (Annual Convention) Sec'y, Joseph C. Knox, 204 Tremont Bldg., Boston, Mass.

SEPT. 19-21—DAVENPORT, IOWA (Hotel Blackhawk)
Iowa Sewage Works Association. Sec'y, Leo Holtkamp, E. Ohio Street, Webster City, Iowa.

SEPT. 26-29—ATLANTIC CITY, N.J. (Claridge Hotel)
Pennsylvania Water Works Association. Sec'y-Treas., C. M. Hartman, 510 Telegraph Bldg., Harrisburg, Pa.

SEPT. 27-29—SANTA FE, N. MEX. (LaFonda Hotel)
Rocky Mountain Sewage Works Association. Sec'y, C. H. Coberly, Room 329, 1441 Welton St., Denver, Colo.

OCT. 1-3 ST. LOUISE. Mo. (Sheraton Hotel)
Missouri Water & Sewege Conference. Sec'y, Warren Kramer, State Office Bldg., Jefferson City, Mo.

OCT. 9-12 WASHINGTON, D.C. (Statler Hotel)
Federation of Sewage Works Associations. Exec.-Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

OCT. 11—WATERVILLE, ME.
Maine Water Utilities Assn. Sec'y, Earle A. Tarr, Supt. Water District, Winthrop, Me.

OCT. 15-18—NEW ORLEANS, LA. (Roosevelt Hotel)
Southwest Section A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

OCT. 24-27—SAN DIEGO, CALIF.
California Section A.W.W.A. (Annual Meeting) Sec'y, Wm. W. Aultman, Box 38, LaVerne, Calif.

OCT. 26-28—ATLANTIC CITY, N.J. (Hotel Madison).
New Jersey Section A.W.W.A. Sec'y, C. B. Tygert, P. O. Box 178, Newark, N. J.

NOV. 6-7—RICHMOND, VA. (Jefferson Hotel)
Virginia Section A.W.W.A. Sec'y, W. H. Shewbridge, 713 State Office Bldg., Richmond, Va.

NOV. 13-15—DURHAM, N.C. (Washington Duke Hotel)
North Carolina Section A.W.W.A. and North Carolina Sewage Works Association. Sec'y, E. C. Hubbard, State Board of Health, Raleigh, N. C.

Because it's BLAW-KNOX "TWISTED BAR" Electroforged Steel Grating

Blaw-Knox Stair Treads available with rolled diamond checker plate nosing, twisted cross-bar nosing or abrasive nosing.

THE twist does the trick—twisted bar construction gives greater traction, makes slipping impossible even if the grating is wet, greasy or icy. The slightly roughened surface grips shoe soles for *extra* safety, yet the over-all surface is level. Trucks and other wheeled vehicles roll freely. In addition, Blaw-Knox Steel Grating is electroforged into one piece for extra strength and durability.

OTHER ADVANTAGES: Maximum open area for light and air. Self-cleaning, easy to maintain, economical to install.

GET THE FACTS FROM BULLETIN 2296

Big new bulletin gives complete details, specifications, possible applications and all the outstanding advantages of Electroforged Steel Grating and Stair Treads. Write for your copy today!

BLAW-KNOX DIVISION of Blaw-Knox Company
2051 Farmers Bank Bldg., Pittsburgh 22, Pa.

BLAW-KNOX ELECTROFORGED STEEL GRATING

"... speed up that job, Bill — use the **HYDRAUGER***"

IT'S A FACT

... on short runs (up to 200') underground pipe can be laid faster and at much less cost in Hydrauger BORED HOLES! (Bore diameters 2" through 24".)

operates by compressed air ... needs only a 2' 6" by 7' 6" trench.

HYDRAUGER CORP., Ltd.
681 Market Street
San Francisco 5, Calif.

GET FREE CATALOG

HYDRAUGER*
Earth Boring Tool
**Reg. U. S. Pat. Off.*
HY-21C

TWO NEW R-C BULLETINS

for smaller volume, moderate pressure applications

If you are handling gas or air for any of the purposes listed below, or for similar applications, you need these two new bulletins on R-C Rotary Positive AF Blowers and XA Gas Pumps.

1. Air for combustion with oil or gas burners, small cupolas, coke-fired forges, etc., in:

- Iron and steel works
- Food processing industries
- Neon sign shops
- Chemical processes
- Nonferrous foundries
- Asphalt heaters
- Smelters
- Oil-fired forges
- Bakeries
- Ceramic, brick and tile mills

2. Aerating and agitating liquids, in:

- Ice plants
- Sewage and industrial waste disposal
- Electroplating, engraving and electrotyping
- Fish tanks or trucks, also shallow lakes
- Oyster washing
- Water treatment
- Protecting dams from ice
- Fruit, vegetable and poultry washing and cooling
- Blending vinegar, fruit juices, etc.
- Compounding oils

3. Miscellaneous pressure or suction uses:

- Pneumatic conveying of grains, insulation and liquids
- Rock dusting in mines
- Dust collecting systems
- Low pressure sandblast
- Respirators and safety helmets
- Testing rubber balloons, etc.
- Cleaning forging dies, motors and machines
- Boosting inlet pressure of compressors
- Drying barrels and drums
- Blowing cake off filters
- Air seal for bearings of rock crushers, etc.
- Pneumatically controlled valves
- Steam garment presses
- Printing presses
- Paper folding machines
- Vacuum chucks
- Drying yarns, textiles, etc.

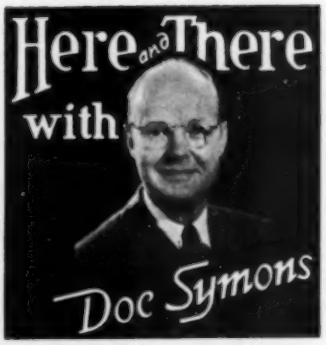
4. Gas Pumps for:

- Boosting fuel supply to industrial furnaces
- Chemical processes and refineries
- Boosting pressure from small gas wells
- Neon sign shops
- Gas sampling equipment
- Inert gas generators
- Exhausting oil vapors
- CO_2 collectors
- Boosting supply to gas engines

These bulletins bring you up to date on construction, capacities, regulation, control and other details on R-C Type AF Blowers (Bulletin 21-B-37) and Type XA Gas Pumps (Bulletin 31-B-17). Send for them or write us about your needs, for engineering analysis, without obligation.

ROOTS-CONNERSVILLE BLOWER CORPORATION
503 Mount Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES



H.T.M.A.—And looking back over some of my recent columns, I find that I failed to fulfill my promise to give you the recipe for Shrimb Shorb. Keep tuned in for the rest of this column and you'll have the makings of a taste treat.

* * *

Small World No. 10—One evening near the end of January, I went to see my favorite Shakespearean play; this time, the motion picture version of Hamlet. Next day, with the spell of the melancholy Dane still on me, what should I find in my mail but a letter from Denmark. Not from Hamlet's ghost, but from G. O. Andrup, Chief of Water Supply of Odense, the third largest city in Denmark.

What pleased me, of course, was his opening sentence: "Dear Doc Symons; Here are my thanks for many a smile you have given me through your column in *Water & Sewage Works* . . ." Mr. Andrup also told me that he is coming to this country under the ECA program some time this year and wants to visit some of the most modern water works, both surface and well.

If you'd like to have him visit you, drop him a card inviting him. Both he and I would appreciate your invitation and help during his stay of four or five months here in the U.S.

* * *

At the annual New York City meeting of the N.Y.S.S.W.A., I had the good fortune to be a member of a panel discussion on which L. A. Danse sat. Mr. Danse, you may know, is not only Supervisor of all Waste Treatment for General Motors Corp., but he is also the industrial representative on the Water Pollution Control Advisory Board, formed to advise on the administration of Pub. Law 845.

Those of you who heard Mr. Danse on that Panel, know that in him we have a friend at court. "In conversation with him, I found he favors changing the name of the Federation

S.W.A. to Water Pollution Control Federation."

* * *

Speaking of the N.Y.S.I.W.A. (it changed its name, you know)—when you meet the new Vice President of that Assn., one J. M. MacCrea, a peddler from Syracuse, it will be quite O.K. if you say—"Hello, Mort!"

* * *

Report to Arthur Clark, Secy-Mgr., Water & Sewage Works Manufacturers Assn.—The annual meeting of the N.Y.S.I.W.A. at the Hotel Statler in New York, on Jan. 20 was climaxed with a delightful social hour (Courtesy of Manufacturers). Of course, every one missed you and I had a lot of explaining to do to tell that you are on leave of absence recuperating.

I thought you'd like to know that your secretary, Miss Dimmers, and her helper, Mrs. Phillips, did an extra fine job on the registration desk.

I guess you'll miss the N.J. Sew. Wks. Meeting in Trenton in March, but I'll see you in Philadelphia in May.

* * *

Oh yes!—At that Social Hour, it seemed like a meeting of the *Society of Council Bluffers.* The Jones (Casey and Dot) and Mary Van Atta were there along with Dan and Lil Saunders, my girl, and A. E. Griffin. Earlier in the week we saw Wendell La Due and associate member Reg Hayes.

We held a short meeting and decided that the annual breakfast of the Council Bluffers would be held after the dinner dance at the A.W.W.A. Meeting on Thursday night, May 18. All members and associate members of the Society are urged to be present by order of President Casey (Simplex Valve) Jones. See me for time and place.

* * *

If you were listening to the Great Gildersleeve in mid-January you heard him say, "And this is a 'Snifter Valve.'" Know where he learned about that? From page R-86 of the 1946 Ref. and Data issue of *Water & Sewage Works.*—'S a Fact.—

And did you hear about the canteen of water he sent to New York via a dozen other cities—with an ounce of water from each for Commissioner Carney in New York.

* * *

As you all know, I'm quite proud of my feminine readers and I was more than pleased last autumn to discover that one of them is Miss Jeanne Porter, Adv. Mgr. of Yeomans Bros., Chicago. Very gratifying to be read by a professional, as well as beautiful eye.

CHECK THESE ADVANTAGES

OF CARLON PLASTIC PIPE*

- Guaranteed Corrosionproof
- Longer Service Life
- Extreme Light Weight
- Flexibility
- Fewer Fittings
- Easier To Install
- Permanent Free Flow
- Lower Shipping Costs

* CARLON PLASTIC PIPE is the modern answer to water and sewage transmission problems. *Guaranteed forever* against rot, rust, and electrolytic corrosion, it has a trouble-free service life many times longer than ordinary pipe.

CARLON'S flexibility and extreme light weight provide for more rapid and economical installation. One man can lay long sections easily and then make connections in two minutes. Many fittings necessary for other pipe are completely eliminated.

CARLON will curve to follow a ditch line or surface contour, and it can be installed above or below frost level because its ratio of expansion exceeds that of freezing water.

Write today for additional information, or call BRoadway 6565 for immediate service.

CARLON CP

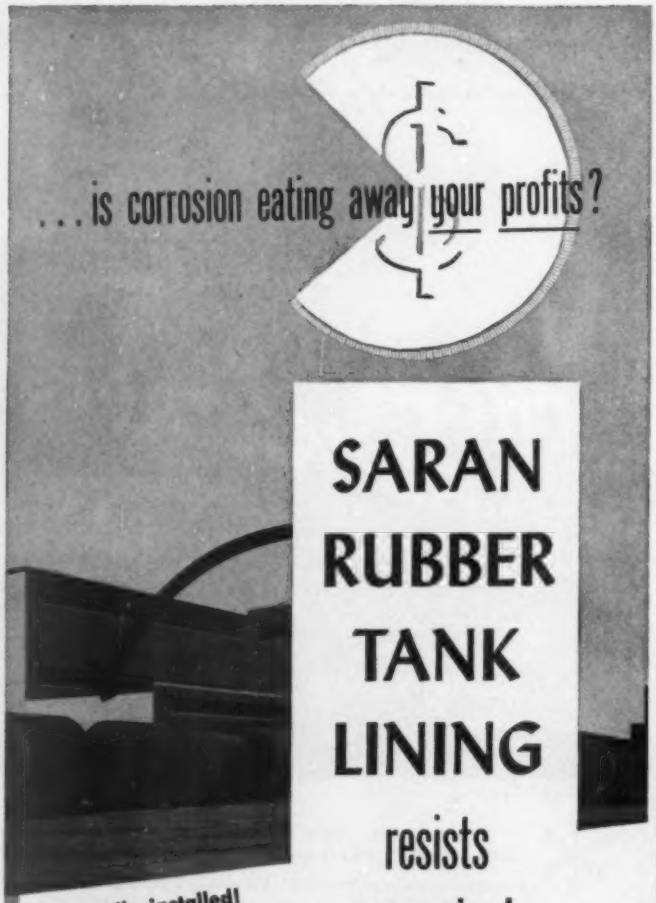
CARTER PRODUCTS CORPORATION

10132 Mosch Avenue

CLEVELAND 5, OHIO

CHECK CARLON SIZES • • LENGTHS • • WEIGHT • • STRENGTH

STD. SIZE	O. D.	I. D.	CALCULATED B. P. P. S. I.	WT./FT.	NORMAL SHIPPING LENGTHS
1/2"	0.840	0.622	540 lb.	0.103 lb.	400 ft. coils
3/4"	1.050	0.824	350 lb.	0.140 lb.	400 ft. coils
1"	1.310	1.070	200 lb.	0.181 lb.	300 ft. coils
1 1/4"	1.660	1.380	200 lb.	0.267 lb.	300 ft. coils
1 1/2"	1.900	1.610	200 lb.	0.320 lb.	250 ft. coils
2"	2.378	2.070	170 lb.	0.445 lb.	200 ft. coils
3"	3.504	3.070	165 lb.	0.91 lb.	100 ft. coils
4"	4.504	4.030	150 lb.	1.25 lb.	25 ft. str.
6"	6.630	6.070	115 lb.	2.25 lb.	25 ft. str.



Saran rubber, developed by The Dow Chemical Company, leads the way to cutting corrosion costs to a minimum. The extremely high degree of chemical and abrasive resistance, found in saran rubber, makes it the outstanding tank lining where the storage and conveyance of grease, solvents, acids or other chemicals is indicated.

Saran rubber can be applied easily and economically by experienced tank lining applicators located strategically throughout the country. Saran rubber lined pipe is available also—8 inch diameters and larger, and up to 20 feet in length.

Get in touch with an applicator today by contacting your nearest Saran Lined Pipe Company office—find out how you can add many years to the life of your costly equipment. Write: Dept. TSP-71.

Distributed by

Saran Lined Pipe Company

701 STEPHENSON BUILDING • DETROIT, MICHIGAN
Offices in: New York • Boston • Philadelphia • Pittsburgh
Chicago • Tulsa • Indianapolis • Houston • San Francisco
Los Angeles • Portland • Cleveland • Denver • Seattle
Charleston, S. C. • Toronto

SARAN RUBBER
DOW
product

My apologies—not as Columnist Doc Symons, but as Ye Assoc. Ed.—I don't feel too worried when I make a mistake in the column because it always furnishes ammunition for another paragraph. But when, in the magazine section of the Dec. issue, I put Dr. Clair Sawyer at Harvard instead of M.I.T., and Jack J. Hinman, Jr. at Ames, instead of Iowa City, Iowa, I should certainly hang my head in shame.

* * *

Also in the Dec. issue, I said that R. W. Moir was a consulting engineer, when everyone knows that he's an engineer with the Metropolitan Sewage Commission of Boston. Psychiatrists probably have an explanation for my lapses—But don't tell me.

* * *

For the benefit of my friends who live on nothing but shrimp, and any one else who likes 'em, I offer you this recipe for **Shrimp Shorb.** It is named after my good friend "Bill" Shorb, Vice President of the Decatur Pump Co., and the fellow I lived with when I worked for Dr. W. D. (Hap) Hatfield at the Decatur, Ill. Sewage Plant long enough ago to admit me to the Quarter Century Club.—This is "Bill's" own recipe, and I guarantee you'll find it most delicious.

For a serving of four or five persons—Take three cans of beer;—yes—I said "Beer"; pour into a large saucepan; place on a low fire and bring to a boil.

Add from two to five pounds of good fresh shrimp (do not remove shells) and the following seasoning: Handful of salt; handful of celery seed; ½ teaspoon red pepper; some bay leaves; a handful of mustard seed; and some cloves. If you prefer, buy some pickle spices and use a couple of handsful.

After you have added the shrimp, etc., the boiling will be killed momentarily. When it starts to boil again, time it for just 20 minutes. Dump the shrimp in a colander and drain. Serve hot or cold.—Peel off shells—the shrimp are deee-licious.

* * *

Gadgets Pay Off—Tom Higgins, Operator of the Sewage Treatment Plant at Rockland State Hospital in New York State had an idea. He thought he could sweat a bushing on the stem of corroded trickling filter nozzles and thereby save the cost of replacement. He took his idea to the mechanic at the hospital and together they worked out a design.—It worked.

Higgins submitted the idea to the N.Y.S.S.W.A. (now N.Y.S.I.W.A.) Gadget Contest and won a prize. This

year he submitted the idea to the N.Y. State Merit Award Board. Because the gadget will save the State of New York several thousand dollars Mr. Higgins and his mechanic were given an award of $200, one of the highest ever made by the board for suggestions submitted by state employees.—Yes sir—Gadgets pay off.

* * *

Final Word—H. T. (Ted) Rudgal, Supt. of Water, Kenosha, Wis., has just advised me that Frank Vilen of Kenosha is the man unidentified in the picture which appeared last October and again on page 82A of the Jan. issue. It is not Tom Hay as M. L. Robbins, of Minneapolis suggested it might be.—Well—that clears that up.

* * *

A fellow named A. Vaughn Chinnock, of the Sales Development Dept. of Hooker Electrochemical Co. in Niagara Falls, N.Y. just couldn't resist calling my attention to the fact that the lead article in the January issue (by Ingols et al) was titled "Measuring Strength of Sewage and Trade Waste—B.O.D. or O.C.," while the Table of Contents said plainly "Measuring . . . etc.—B.O.D. vs. C.O.D."

Chinnock adds "People have more fun than anybody . . ." Then I'm definitely not people, for I'm the guy who made up that Table of Contents page—But O.C. or C.O.D.—Oh Me!

* * *

Down Tennessee Valley Authority way is a fellow named F. W. (Kit) Kittrell, who is Chief of the Stream Sanitation Section. Not long ago, "Kit" and his young son, Cary, were driving past a cemetery, and young Kittrell asked, "Daddy, what kind of an engineer did you say you are?"

"A Sanitary Engineer, son."

There was a long pause—

"Oh, I thought you said a cemetery engineer!"

And all along, says "Kit", he thought he'd been keeping people out of the cemetery instead of engineering them in.

* * *

Left over for next issue, an item on public relations; a translation from a French newspaper by my rural editor, Nels Fuller of Batavia; and a letter I wrote to Pete Wisely, plus a story about Tom Lanning and a snake, and —oh—some other stuff.

V.T.Y.—Doc

"THE impossible is that which we have not yet learned to do."
W. R. WHITNEY

WARREN
Solves Your
PIPE
PROBLEMS
BELL & SPIGOT PIPE • FLANGE PIPE • MECHANICAL JOINT PIPE • FLEXIBLE JOINT PIPE • SPECIAL CASTINGS • SHORT BODY BELL & SPIGOT SPECIALS •
Warren Cast Iron Pipe and Fittings can be supplied in all sizes 2" to 84" with all types of joints and in accordance with Standard Specifications. Specify "Warren Pipe" for your next job.
Take advantage of our large stock of non-standard patterns, when in need of special castings to meet your individual requirements.
Warren
FOUNDRY & PIPE CORP.
55 LIBERTY ST. — N. Y. C.
WARREN PIPE CO. of MASS. INC.
75 FEDERAL ST., Boston, Mass.

Phipps & Bird
LABORATORY MIXER

IS the important piece of equipment in the Modern Water Works Laboratory. Now being used by leaders in water works research. Many superintendents and chemists have been able to reduce their chemical costs by the control of chemical dosage with this mixer. Write for literature.

PHIPPS & BIRD, INC. Richmond, Va.

DARLEY MAGNETIC DIPPING NEEDLE
$17.50

with 3 section telescoping handle
$22.25

Write Today for 68-Page Catalog

W. S. DARLEY & CO., Chicago 52

THE SPILLWAY

[Overflow from the main section]

Federal Grants for Water Pollution Studies

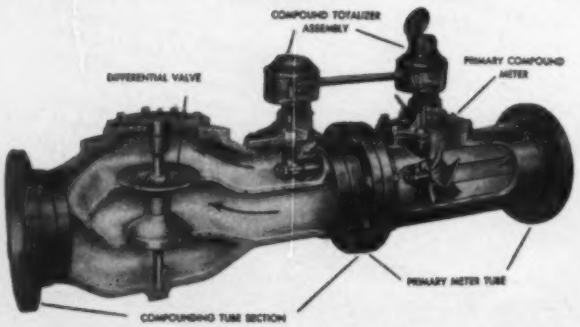
The Public Health Service of the Fed. Sec. Agency has granted $891,487 to State and interstate agencies and territories, for studies of water pollution resulting from industrial wastes. The grants are being made from a $1,000,000 appropriation to the Fed. Sec. Agency. Approximately 85 per cent has been set aside for the states and territories. Of the remaining 15 per cent, $72,400 has been paid so far to interstate agencies, and an additional $67,508 is being used for grants for special industrial waste studies having sectional or national importance; it can be applied to either state or interstate agencies.

Grants to interstate agencies include: Potomac River Basin—$8000; New England Water Pollution Control Commission—$10,000; Ohio River Compact Comm.—$29,000; Interstate Sanitation Comm.—$13,000; and INCODEL—$12,400.

Grants for special studies of national significance have been made to Massachusetts ($12,500 for wool scouring wastes); Texas ($14,000 for citrus wastes); and Wisconsin ($9,608 for studies on uniform standards).

Provisional allotments have been made to Ohio, Washington and Minnesota for special studies on electroplating wastes, toxicity to aquatic life, and beet sugar wastes respectively.

SPARLING MAIN-LINE METERS



Differential valve cracks at about one pound per square inch back pressure from the smaller meter. The smaller meter measures all flows below the minimum accurate range of the larger meter. Both meters drive through ratchet clutches to a common totalizer, which thus operates with the faster turning meter.

COMPOUNDS
for
Accuracy over WIDE Flow-Range
Low Pressure Loss

With a Sparling Compound Meter you are assured of Measurement accurate within 2 per cent over flow-ranges as wide as 1 to 125. Sizes, 6-inch to 36-inch.

Important, too, are high conservation of pressure in the line, the single totalizer for easy reading, and the elimination of sharp cutover point between the two elements!

•

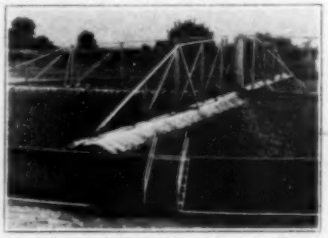
Quotations and Bulletin 310 come at your request

The SPARLING Manufacturers of WATER MEASURING EQUIPMENT

LOS ANGELES 54.....Box 3277
CHICAGO 8.....1500 South Western Ave.
BOSTON 8.....6 Beacon Street
622 Broadway.....CINCINNATI 2
101 Park Avenue.....NEW YORK 17
1932 First Avenue.....SEATTLE 1
DALLAS 1.....736 Reserve Loan Life Bldg.

Stockton, Calif., Plant Handles Canning Waste

Stockton, Calif., had a problem, two problems in fact, the first to treat its domestic sewage AND a large volume of canning waste and secondly to complete the treatment plant trickling filter units in 90 days in order to beat the canning season.



Shown in the accompanying photograph is the trickling with PFT rotary distributor completed in exactly 90 days from the award of the contract. And not a day too soon. Next day canning started. Because of the variable volume load, the distributor had to be designed to handle a range of flows from 3.67 to 10 mgd.

According to the designer of the plant, Clyde C. Kennedy, Cons. Engr., San Francisco, Calif., the seasonal characteristics of the canning industry made an unusual problem of design. Normal domestic sewage flow for the city is approximately 4.0 mgd., but during the canning season the flow is from 2½ to 3 times that. To handle this wide variation in volume load, the trickling filter distributor was designed for flows of 3.67 to 10.0 mgd. Because of the presence of fruit pits and pieces of fruit that pass the screening and settling parts of the plant, the distributor was equipped with PFT removable spreader jets to allow for quick cleaning even during operation. Mr. Kennedy reports that even at a load of 12 mgd. operation has been successful.

Here's a Good Tip for Everyone who wants to reduce Maintenance on Waste and Vent Lines

It's safe to say that *every* building with sanitary facilities has a corrosion problem . . . and that unless proper safeguards are used, you'll soon be paying for repairs, with replacement not far ahead.

Two of the worst trouble-makers are waste and vent lines. They are exposed to multiple attack from water . . . organic wastes . . . oxygen from the air . . . carbon dioxide . . . and sewer gases, which include ammonia and hydrogen sulfide. Any one of these is a dangerous enemy to pipe life. In combination, they represent a major hazard, and the only practical protection is through the use of a corrosion resistant material.

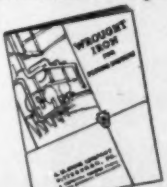
Wrought iron has been used in these severe services for long periods, and its superior durability

has been certified by service records of 50 years or more. In one study of a number of old buildings, wrought iron vents were still serving in one building after 49 years —in two after 48 years . . . and in three others after more than 45 years. In contrast, in a group of eleven buildings where low-first-cost materials had been used for vents, the life *to failure* averaged less than 23 years. In another study of a group of buildings over 20 years old, the engineer estimated the depreciation as 20% for the wrought iron vents, and 90% for the other material. Similar impressive performance figures support the choice of wrought iron for waste lines.

You'll find the reason for wrought iron's unusual durability in its unique composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse corrosive attack, and so discourage pitting. Furthermore, the fibers help

to anchor the initial protective scale, which shields the underlying metal.

Our bulletin, WROUGHT IRON FOR PIPING SYSTEMS discusses the corrosion problems encountered in sanitary lines, and gives the results of several engineering studies. You'll find this book a big help in selecting piping for maximum life and minimum cost in waste and vent lines, as well as in other services. Ask for a complimentary copy.



A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS

New York City Awards $6,000,000 Contract on Owl's Head Sewage Plant

Completed Plant Will Cost $22,500,000

The awarding by New York City of Contract No. 5 in its next five-year sewage treatment program was announced today. The successful bidders were Thompson-Starrett Co., Inc., builders, whose bid for structures and equipment for the Owl's Head (Brooklyn), Treatment Plant was awarded on the basis of alternate bid at a bid price in excess of $6,000,000. It covers the major structures and equipment in the $22,500,000 Owl's Head High Rate Activated Sludge Plant which is expected to be placed in operation in 1953. This plant will further cut pollution by 160 MGD.

Borough of Queens Installs New Type Pipe Tester

To modernize its municipal laboratory for testing sewer pipe and structural material, the Borough of Queens, New York City, has installed

a new type of testing machine of 200,000 lb. capacity. The testing machine is a new type design developed by the Baldwin Locomotive Works, Philadelphia, Penna.

Shown in the accompanying photograph is the new machine determining the compression strength of a 72-in. concrete sewer pipe. It required 112,000 lb. pressure to crack the pipe. Watching the test are Leo Kampf, Laboratory Chief; Borough Consulting Engineer William Raisch, and Queens Borough Works Commissioner Maurice A. Fitzgerald.

FILER & STOWELL SLUICE GATES

are built to stand long trouble free service. Amply proportioned for all stresses of shipment, erection and operation. They may be obtained with manual, hydraulic cylinder or motor operating controls.

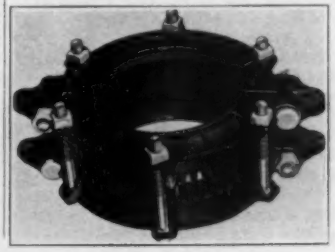
THE FILER & STOWELL COMPANY
MILWAUKEE 7, WISC.

MANUFACTURERS' *and* EQUIPMENT NEWS

301
Split Coupling Clamp

M. B. Skinner Co., South Bend, Ind., has available a Split Coupling Clamp for repairing cast iron mains. This device is so simple to operate that it can be installed by one man in fifteen minutes. At the same time it is so effective that it not only splices a break but insures against recurrence of trouble by introducing a degree of flexibility in the line at the point repaired.

Gasket sealed, this split coupling clamp can also be used for pin-hole



leaks or splits in cast iron brazed joints, or to replace without disturbing the line, mechanical couplings which are leaking.

For further information on this repair clamp, use a Reader Service Card on which is entered the above key number and your name and address.

Horandt Neptune's Pac. Coast Mgr.

Henry Horandt has been appointed Pacific Coast Manager for Neptune

Meter Co. according to an announcement by J. R. Barker, Vice Pres. in Charge of Pacific Coast Sales.

In his new position, Mr. Horandt will be in direct charge of all sales, office, and warehouse personnel in Los Angeles, San Francisco, Portland, and Denver.

302

Extruded Plastic Pipe

Carter Products Corp. has announced the availability of Carlon "EF" a new plastic pipe which has been developed especially to handle

water intended for human consumption. It is particularly suitable for piping jet wells, transmitting drinking water in municipalities, and it can be used for transmission of chemicals, domestic and industrial sewage, and for radiant heating systems. It is practically unbreakable, has a long

PIPE VISE

plus... a handy work bench

RIDGID Tristand's tray keeps all your tools in easy reach

● No stooping, less fatigue and speedier work now that you don't have to bend over every time you change tools. New tray attaches in a jiffy, makes Tristand rigid so it can't fold up in use. Legs have rubber feet to prevent creeping. RIDGID's LonGrip tool-steel jaws won't slip, won't mar polished pipe and tubing. Yoke vise, 2½" capacity; chain vise, 4." Buy new work-saver RIDGID Tristands from your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

projected service life and while its tensile strength is not as great as that of metallic pipe it is more than sufficient for normal purposes.

To obtain more information on this new plastic pipe, use a Reader Service Card on which is entered the above key number and your name and address.

Municipal Service Co. Reactivated

The reactivation of Municipal Service Co., of Kansas City, a contract engineering firm engaged in the manufacture and installation of mechanical equipment for water and sewage plants, has just been announced by its parent organization, J. F. Pritchard & Co., also of Kansas City. The reactivation became effective on January 3, 1950.

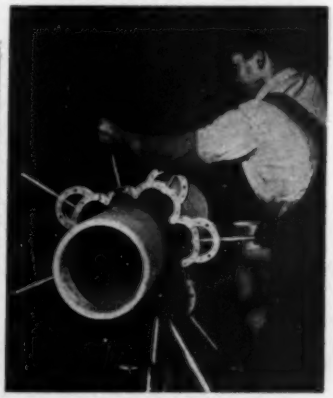
First organized and incorporated in 1930, Municipal Service Co. was active in the construction of filtration plants until the end of 1942 when it ceased operations due to wartime service of its personnel.

Now, with the return of its experienced personnel, and greater facilities from the parent company, Municipal Service Co. again offers its services to the water and sewage works fields on a nation-wide basis.

303

Versatile Pipe Cutter

The new Model 4 PILOT PIPE CUTTER, for asbestos, cement and claypipe, offered by the Pilot Manufacturing Co. of San Francisco represents a further improvement on the



Pilot principle of multiple-handle construction in pipe cutters.

The Pilot is believed to be the original asbestos-cement pipe cutter. The manufacturer states that field users of five years standing consider it the fastest, most efficient and easiest-to-use cutter on the market.

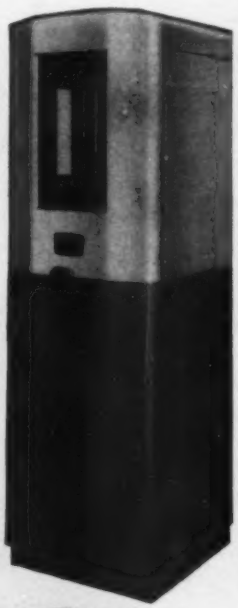
The new Model 4 is easy to use even in the hands of inexperienced workers. Its unique design (see cut) renders the cutter adjustable to all diameters, and there are no removable small parts to lose or misplace. The tool features ball-tipped handles for easy gripping and turning, and blades can be replaced without a key, screwdriver or wrench. The Pilot Cutter cuts in less than one-fourth the time required with a hand saw, on the job or in the shop. Cuts are *always* square and clean. Damaged ends may be cut as close as ¼" without weaving or traveling of the cutter. The Pilot operates above or below ground, and can be used even under water.

Users report up to 1000 cuts per blade-sharpening, and the ease, speed and simplicity of operation mean economy in labor and time.

The basic unit of the Pilot Pipe Cutter handles all classes of 3", 4" and 6" asbestos—cement—or clay pipe. Its range can be increased up to 20" pipe, in all classes, by simply snapping on additional handle assemblies. The Pilot is also realistically priced.

(*Continued on page* 103A)

SUPER-SAFE!



Builders Chlorinizers set a new high in safe operation. Their safety features go into action automatically and positively. The chlorine control valve with many hundreds of pounds seating pressure instantly shuts off flow of chlorine gas if ANY condition occurs to interfere with SAFE operation of the Chlorinizer: loss of vacuum, breakage of glass parts, water failure, or injector stoppage. Additional safeguards prevent troublesome seepage or escape of chlorine into the room.

Chlorination with Builders Chlorinizers is truly super-safe . . . and super-simple, as well. Your regular plant personnel can easily handle the operation and servicing of these modern feeders. Chlorinizers are readily adapted to semi-automatic, program, or automatic proportional systems. For engineering information and descriptive Bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence 1, R. I.

BUILDERS Chlorinizers

The chlorine gas feeders with extra features

BUILDERS PRODUCTS

The Venturi Meter • Propelloflo and Orifice Meters • Kennison Nozzles Venturi Filter Controllers and Gauges Conveyoflo Meters • Type M and Flo-Watch Instruments • Wheeler Filter Bottoms • Master Controllers Chlorinizers — Chlorine Gas Feeders Filter Operating Tables • Manometers Chronoflo Telemeters

BUILDERS—PROVIDENCE Instruments

READER SERVICE CARDS for

WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

JUST
CLIP
THESE
CARDS
MARK
AND
MAIL —
TO
RECEIVE
THE
LATEST
INFORMATION
OR
LITERATURE
DESCRIBED
IN
THIS
ISSUE

Place Stamp Here

WATER & SEWAGE WORKS
135 East 44th Street
New York 17, N. Y.

Reader Service

Place Stamp Here

WATER & SEWAGE WORKS
135 East 44th Street
New York 17, N. Y.

Reader Service

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

Write key number of item you desire here →

Your name .....

Title .....

Company or Dept. .....

Address .....

WATER & SEWAGE WORKS READER SERVICE

READER SERVICE CARDS HOW TO USE THEM

Please fill out a separate coupon for each item on which you desire information. This will greatly facilitate handling.

Key number is at head of each new product, item of equipment, catalog or bulletin, described in this issue.

Enter key number in box.

Please PRINT your name and title, company or department name, and your address

NOTE—

Those cards are to be used only for items described in THIS ISSUE

WATER & SEWAGE WORKS

Will see that you receive information desired.

(*Continued from page* 102A)

For additional information we have inserted for your convenience Reader Service cards, which should be filled out with the key number at the head of this announcement, your name and address.

Worthington Div. to Power Los Angeles Hyperion Plant

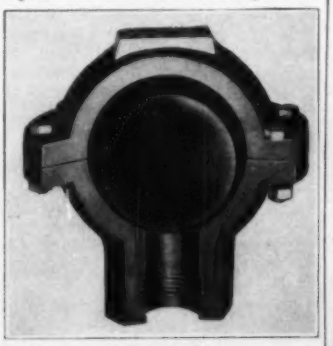
The new Hyperion Activated Sludge Plant for Los Angeles will contain nine Worthington Supercharged Dual Fuel 8-cylinder Diesel-Gas engines. Five of the 16-inch bore, 20-inch stroke engines will be installed in the power plant to drive A.C. generators which will produce all electricity to power various equipment in the entire plant. The remaining four engines will drive 2-stage centrifugal blowers each having a rated capacity of 40,800 cfm. at 7¼-psi. supplying air for the activated sludge process.

The Hyperion plant will treat 245 mgd. and will cost $41 million, of which $3.5 million will go into the power and blower building and equipment.

304

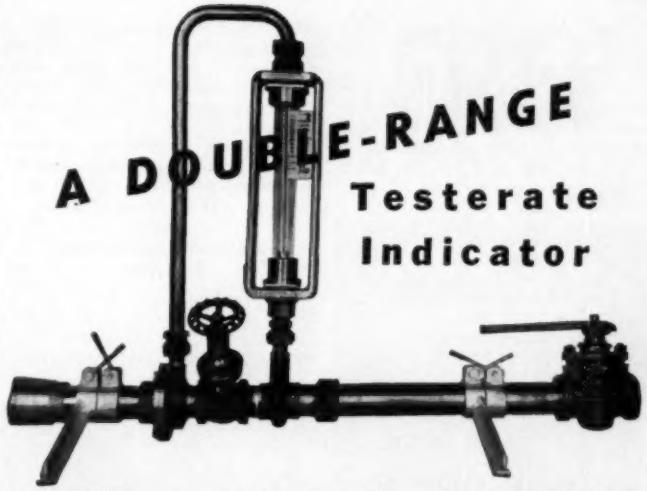
Pipe Line Shock Absorber

R-S Products Corp., Wayne Junction, Philadelphia 44, Penna. has developed a complete line of compact liquid shock absorbers designed to



eliminate shock and hammering in pipe lines and liquid systems. Hammering, leaky joints, opened pipe seams, and excess pressure on valve packings can be reduced to a minimum when such damage is caused by quick closing of valves or other interruptions of liquid flow.

Three of five models, designated as Industrial, Dual and Super, are adapted for general industrial use. There are no moving parts; a rubber cushion, encased in spherical metal



. . . you can take out on the job

WRITE FOR CATALOG 50

It contains full information about the Double Range Indicator and other valuable meter testing and setting equipment. FREE.

With this Portable Double Range Testerate Indicator you can field test meters at rates of flow anywhere between ¼ g.p.m. and 175 g.p.m. Accuracy is within 2%. The value of the time saved is considerable. Each Indicator is equipped with lubricated plug valve, spring-loaded check valve and four adjustable supporting legs.

The TESTERATE INDICATOR

FOR BETTER WATER SERVICES

FORD

Manufactured by THE FORD METER BOX COMPANY, INC.

Wabash, Indiana

ZECO GREENSAND ZEOLITE

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. COREXITE mineral for corrosion control and water stabilization.

ZEOLITE CHEMICAL CO.

Sales Office 340 Cedar St., New York, N.Y. Factory Medford, N.J.

Pioneer Producer of [illegible]

ANTHRAFILT

Trade Mark Reg. U. S. Patent Office

A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.

Anthracite Institute Building Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to:

PALMER FILTER EQUIPMENT CO.

822 E. 8th St. Erie, Pa.

Engineers and Sales Agents

chamber absorbs the shock. These devices can be installed in any position.

For further information on this new device, use a Reader Service Card on which is entered the above key number and your name and address.

Dresser Builds New Plant

As a part of its projected expansion program, Dresser Manufacturing Div., Bradford, Penna., has added three new buildings to its plant. The new buildings will be ready about May 1 and will provide for enlargement of Engineering Design and Product Development Laboratories as well as provide required space for full scale manufacture of many new products which have now passed the experimental stage. Among these new products are Corrosion Shields, special insulating gaskets, and Dresser Bonds. Dresser is celebrating its 70th anniversary this year.

305

New Ion Exchange Process

The Resinous Products Div. of Rohm & Haas Co., Philadelphia, Penna., has announced a new technic for ion exchange. This new system utilizes but one single passage of water through a mixed bed of Amberlite ion exchange resins. Complete removal of inorganic salts is obtained without deviation from a pH of 7.0.

Advantages of the mixed bed process include reduced costs of both equipment and regeneration; lower rinse requirements; uniform performance in intermittent service; and a sharp break-through at depletion of the bed.

To obtain further information on this new mixed bed ion exchange system, use a Reader Service Card on which is entered the above key number and your name and address.

"YES SIR, THIS AMERICAN METER HAS GIVEN FINE SERVICE EVER SINCE I'VE BEEN HERE--AND THAT'S A LONG TIME!"
AMERICAN (Bronze Case) WATER METERS
NIAGARA (Galv. Iron Case) WATER METERS
25 to 35 years service is practically "standard operating procedure" for fine-quality AMERICAN and NIAGARA Water Meters. One of the main reasons for this long-lived performance is their simplicity of design, which utilizes fewer working parts . . . increases operating efficiency . . . simplifies parts replacement.
BUFFALO METER CO.
2909 MAIN STREET, BUFFALO 14, N. Y.

Hooker to Increase Chlorine Production at Tacoma

E. R. Bartlett, President of the Hooker Electro-Chemical Co., has announced that the company is to increase production of chlorine and caustic-soda at Hooker's Tacoma, Washington plant.

The increased production is to be effected largely through the replacement of existing electrolytic cells with the new Type S-3 cells which have a far greater capacity for producing chlorine and caustic soda. The new cell is a recent development of Hooker Research and Engineering.

In addition to the cell replacement program, there will be installed the most modern and up to date equipment for handling and treating the brine, which is fed to the electrolytic cells, and new equipment for liquefying and purifying the chlorine.

Hooker's increased production of chlorine at Tacoma is the result of an ever increasing market for chlorine on the West Coast.

306

Safety Chart on Chlorine Handling

Pennsylvania Salt Co., Philadelphia, Penna. has issued a new durable wall chart on accident prevention and safety measures to be followed in the handling of liquid chlorine.

The wall chart contains suggestions on employee protection, equipment maintenance precautions in locating leaks and first aid suggestions based upon accident prevention experience. In this wall chart form, this information may be more readily available for guidance to the employee.

The chart is 14 by 19 inches and printed in green and black on linen backed paper. Top and bottom are metal bound with metal hangers attached.

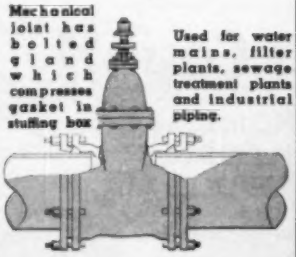
To obtain one of these charts, use

Mechanical-Joint

HYDRANTS & VALVES

In addition to bell-and-spigot and flanged, we now offer M&H Valves and Hydrants with mechanical-joints for use with standardized mechanical-joint Cast Iron Pipe.

Mechanical joint has bolted gland which compresses gasket in stuffing box



Used for water mains, filter plants, sewage treatment plants and industrial piping.

VALVES: A.W.W.A. type iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke. Also furnished hydraulically operated. Square bottom type operates in any position.

HYDRANTS: Standard A.W.W.A. type approved by Underwriters and Factory Mutuals.

M & H PRODUCTS INCLUDE

FIRE HYDRANTS
GATE VALVES
WALL CASTINGS
SPECIAL CASTINGS
TAPPING SLEEVES AND VALVES
CHECK VALVES
FLOOR STANDS
EXTENSION STEMS
SHEAR GATES
MUD VALVES
VALVE BOXES
FLAP VALVES
SLUDGE SHOES
FLANGE AND FLARE FITTINGS
FLANGED FITTINGS
B & S FITTINGS
CUTTING-IN TEES

M & H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

a Reader Service Card on which is entered the above key number and your name and address.

Dearborn Chemical Promotions

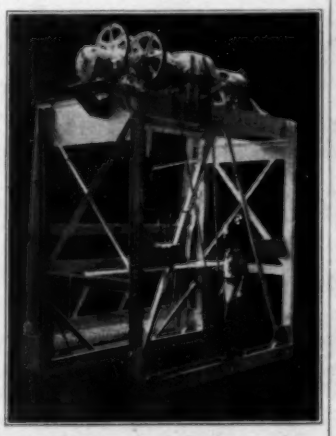
Dearborn Chemical Co., manufacturers of NO-OX-ID rust preventive, has announced several new appointments in various departments. C. C. Rausch, Asst. Vice President, has been appointed Manager of the Industrial Department's NO-OX-ID sales. J. G. Surcheck has been made assistant manager of all production. E. M. Welch has joined the Chicago office as Manager of Sales of Water Treatment and Equipment. C. S. Silsbee has been named Asst. Manager in charge of all national accounts and service.

A. H. Reynolds, formerly Directing Chemist, becomes Director of Product Development and will be assisted by L. O. Gunderson. Dr. Wayne L. Denman has been promoted to position of Directing Chemist of Dearborn Laboratories, and Milton H. Hagman becomes Controller.

307

Mechanical Rack Rake

Newport News Shipbuilding and Dry Dock Co., Newport News, Va., has a mechanical rack rake, power operated, for cleaning trash racks at



water intakes for pumping stations, hydro-electric plants etc. It cleans rack bars of trash such as leaves, grass, sticks, bark, logs, and reduces what was formerly a major hand operation to one of minor periodic power activity.

With the Newport News mechanical rack rake installation, one man per shift can under ordinary conditions keep the racks clean for a dozen bays. This rack rake has been built to

FREE

to WATER WORKS and SEWAGE MEN

HOW TO CONTROL ALGAE

"The Use of Copper Sulphate in Control of Microscopic Organisms" by Dr. Frank E. Hale (former Director of Laboratories, Dept. of Water Supply, City of New York) is an authoritative work concerning the control of micro-organisms and elimination of tastes and odors. Describes in detail methods of controlling various forms of microscopic life commonly encountered in water supply systems. Contains descriptive material, plus 48 photo-micrograph studies of organisms discussed.

ROOT AND FUNGUS CONTROL

"Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," by John W. Hood, contains information published for the first time. This material includes actual methods for control and operating procedure. Here's the book that is a "must" for all sewage men.

GET EITHER OR BOTH OF THESE BOOKLETS ABSOLUTELY FREE—
These two valuable booklets, so important to all water works and sewage men, are yours *without obligation*. Mail coupon below!

Write Today, Supply Limited!

PHELPS DODGE REFINING CORPORATION
40 Wall Street, New York 5, N. Y.

Please send my free copy of (check one or both):

☐ "Control of Microscopic Organisms"
☐ "Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains"

Name _____ Title _____
Employed by _____
Address _____
City _____ Zone _____ State _____

WS-350

operate on racks 5 ft. 6 in. to 28 ft. 6 in. in width. The rake is designed to operate in channel guides as shown in the accompanying photograph. Local conditions and the nature of the trash determine the method of trash disposal. The unit can travel from one rack to another.

Persons charged with the design or construction of water intake racks should look into this piece of equipment. To obtain further information on this unit, use a Reader Service Card on which is entered the above key number and your name and address.

DeLaval Promotions

DeLaval Steam Turbine Co. has announced several executive promotions. James P. Stewart, Vice President and Manager of Commercial Sales Div. has been elected Executive Vice President; he will continue as manager of the Commercial Sales Div.

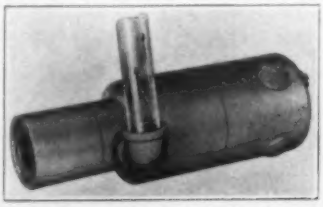
W. A. Reynolds, Manager of the IMO-DeLaval Products Div., has been appointed Assistant to the President.

W. A. Neumann, Jr., Controller of the company has been appointed Acting Manager of the IMO-DeLaval Products Division, and will remain as Controller.

308

Bilge Pump

The Marine Division, Bogue Electric Mfg. Co., Paterson, N.J. has developed a new type high capacity



Bilge Pump. The entire unit is completely submersible and will handle either fresh or salt water at 80 gpm. at 20 ft. head. In addition to its use on ships and boats, this unit will find use on low level construction requiring high capacity water removal and in sumps.

New Automatic Control Reps.

Automatic Control Co., St. Paul, Minn., has announced the appointment of two new representatives. In Buffalo, N.Y., Dean M. Thomas will operate in the Western New York area from headquarters at 1807 Elmwood Ave.

Lou Hoffman, Albuquerque, N. Mex., will act as representative for the company in the New Mexico area.

W. O. Merritt Sales Promotion Mgr. Clayton Mfg.

Announcement has been made of the appointment of William O. Merritt as sales promotion manager of Clayton Manufacturing Co., El Monte, Calif. In his new position Merritt will work with the advertising, training, and promotion activities of the company. He was formerly with the Bear Mfg. Co. of Rock Island, Ill., in charge of public relations, sales promotion and training.

309

Calculating Device

Coleman Instruments, Inc., Maywood, Ill. has developed the Coleman Chemputer as a new convenience for the laboratory chemist or technician. Based on equipment originally developed for aerial navigation, it con-

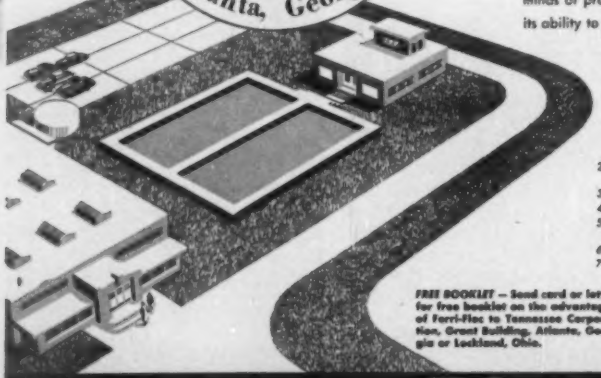
TC TENNESSEE CORPORATION

TENNESSEE CORPORATION
Ferri-Floc
TC
FERRIC SULPHATE
Atlanta, Georgia

Results Count!

• MORE ECONOMICAL
• EASIER TO HANDLE
• SUPERIOR RESULTS

The use of Ferri-Floc in water supplies has several advantages over other coagulants now in use. Economy of operation is a great factor in the minds of prospective users, but, once used Ferri-Floc immediately shows its ability to produce a higher quality of water at a lower cost.



ADVANTAGES OF FERRI-FLOC

Coagulation is effective over a much wider pH range than with alum. Color flocs may be formed in the very acid range, where alum may not be employed. On the other hand, true hydrated ferric oxide flocs may be formed at pH 9-10, or even higher for the removal of turbidity and manganese.
2. The time required for floc formation, conditioning, and settling is in many cases considerably shorter than that required for other coagulants.
3. Filter runs have been markedly increased in several cases.
4. Manganese is successfully removed at pH values above 9.
5. Effluents may be produced which are exceedingly low in both iron and aluminum.
6. Hydrogen sulfide is removed, and taste and odor improved.
7. Ferric floc does not seem to stick to sand grains to form mud balls, and is subject to less "breaking through" on the filters.

FREE BOOKLET — Send card or letter for free booklet on the advantages of Ferri-Floc to Tennessee Corporation, Grant Building, Atlanta, Georgia or Lockland, Ohio.

TENNESSEE TC CORPORATION

Leopold

DRY CHEMICAL FEEDERS
Type L-P

Where quality, accuracy and long life are desired, Leopold Chemical Feeders have long been the standard for feeding predetermined quantities of alum, lime, soda ash, carbon or other dry materials at a uniform rate. Made in several sizes and capacities adjustable to suit a wide variety of operating requirements, the Leopold L-P Dry Chemical Feeder is compact, light in weight and durable, with all parts easily accessible. Simplicity in design keeps wear on parts at a minimum. Feeders are attractively finished with enamel paint and are the totally enclosed cabinet type.

Complete water purification and sewage plant equipment

Write today for complete information

F. B. LEOPOLD CO., INC.
2413 W. CARSON ST., PITTSBURGH 4, PA.

FOR BETTER
pH Control
and WATER TESTS
there is nothing like
NON-FADING
GLASS COLOR
STANDARDS

Pocket Comparator No. 605

Permanent reliability of Hellige Glass Color Standards, accuracy of color comparison, simplicity of technique, and compactness of the apparatus are exclusive features of Hellige Comparators.

WRITE FOR BULLETIN No. 602

HELLIGE
INCORPORATED
3718 NORTHERN BLVD. LONG ISLAND CITY 1, N.Y.
HEADQUARTERS FOR COLORIMETRIC APPARATUS

sists of a pair of sliding scales plus a hairline finder.

A single setting of the scales will instantly solve any problem of simple proportion, or will calibrate any instrument or analytical method yielding linear data. Results are read directly on the scale without prepering tables

or curves. Once linear calibrations are set, they may be retained for future use. The device can be simply reset to provide new calibrations for changes in standard data or methods.

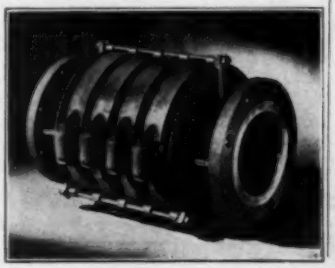
For further information on this new laboratory tool, use a Reader Service Card on which is entered the above key number and your name and address.

Don Anderson Sales Mgr. Jaeger Pumps

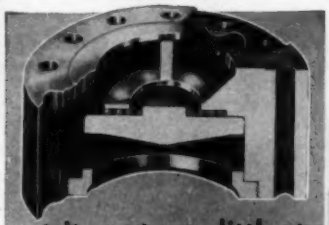
Announcement has been made of the promotion of Dan Anderson to the position of sales manager of the pump department of the Jaeger Machine Co., Columbus, Ohio. He has been with the company for 15 years and was in charge of pump testing before entering the sales division in 1940. A. C. Saxe, manager of the pump department, will continue to direct all engineering service and development works.

310 Packless Expansion Joint

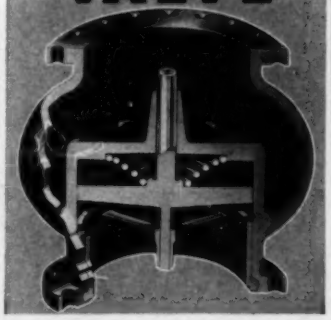
American District Steam Co., North Tonawanda, N.Y., has introduced a new "Corruflex" Packless



WATER HAMMER
can cost
a Fortune



yet it costs so little to correct with
THE WILLIAMS-HAGER
flanged SILENT CHECK
VALVE



Used and specified on hundreds of new buildings—and installed on thousands of old buildings to prevent costly "Water Hammer"—the Williams-Hager Flanged Silent Check Valve will solve your problem, too! Write for new technical bulletin.

THE WILLIAMS GAUGE CO.

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Steam Traps . . . Pump Governors . . . Feed Water Regulators . . . Water Columns

1800 PENNSYLVANIA AVE. - PITTSBURGH (12), PA.

Expansion Joint. This joint may be used to absorb expansion and contraction due to temperature changes in steam, liquid and gas pipe lines.

It requires no packing and is suited for use in remote and difficult-to-service locations. "Corruflex" is available in sizes from 3 to 24 in.

For further information on this Joint use a Reader Service Card on which is entered the above key number and your name and address.

Link-Belt Expands Kansas City Facilities

Link-Belt Co. has announced the opening of a factory branch store and warehouse in Kansas City, Mo., at 2630 Holmes St. The new factory branch store will be under the direction of Arthur J. Olson, District Manager.

311

Sewer and Drain Cleaner

Associated Specialties Co., Inc., Detroit 13, Mich., has developed a new sewer and drain cleaner. Known as "Dig-No-Mor," this new chemical is effective in opening clogged sewers, as well as drains, sinks, toilets, and septic tanks. This chemical compound attacks roots, paper, grease, hair, etc. "Dig-No-Mor" may be obtained in 20, 40, and 100 lb. steel drums.

To obtain more information on this new material, use a Reader Service Card on which is entered the above key number and your name and address.

Graver Appoints Representatives

Graver Water Conditioning Co., New York City, has announced the appointment of two new representatives.

In Los Angeles, Calif., Fred S. Renauld & Co., with offices at 1014 W. 84th Place will represent Graver, and in Buffalo, N.Y., Brookman-Kron Associates, at 259 Delaware Ave., will represent the company.

Standard Steel Buys Hersey Drying Machinery Div.

Announcement has been made that Standard Steel Corp. of Los Angeles has purchased outright, the Drying Machinery Div. of Hersey Manufacturing Co. of Boston, Mass. Plans call for manufacturing in the east as well as in the main plant in Los Angeles.

312

Variable Speed Motor

Sterling Electric Motors, Inc., Los Angeles has announced that its variable speed motor, the Sterling "Speed-Trol" is now available in the "Klosd-Tite Fan-Cooled" design.

This totally enclosed fan-cooled variable speed unit is considered ideal for applications located in dusty or

CENTRILINE called to Toledo 6 TIMES IN 13 YEARS

IN 1937, the city of Toledo, Ohio, asked Centriline to put a 3/16" cement mortar lining in 15,000 feet of brand new 48" welded steel pipe—after the line had been laid and tested. The results were so good that Toledo has since awarded Centriline 5 additional contracts.

There are many reasons for this success. Centrilining protects vital mains against tuberculation. It permanently increases carrying capacity—keeps down maintenance and pumping costs on new installations, often permits the use of smaller diameter pipe, resulting in lower initial cost.

Are performance and economy important in your community, as well as in Toledo? Read Centriline's 28-page illustrated bulletin—sent on request. Consult our hydraulic engineers now—before pumping costs go even higher.

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

140 CEDAR STREET, NEW YORK 6, N.Y.

Branch Offices in all Principal Cities in the United States and Latin America.

CEMENT MORTAR LININGS FOR WATER MAINS CENTRIFUGALLY APPLIED . . .
In strict conformity with A. W. W. A. Specifications.

Quality that Lives

Mechanical equipment for water filtration that carries the Roberts Filter nameplate has long been recognized as equipment that gives lasting service. Installations thirty and more years old are still working "round the clock". However, even the finest equipment may need a replacement part occasionally, then you'll be glad you have Roberts Filter, for no part, however small, is an orphan after installation. Replacement parts can be supplied quickly, eliminating delays that are not only costly but often vital.

For water treatment equipment with quality that lives—specify Roberts Filter.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MANUFACTURING CO.
607 COLUMBIA AVE., DARBY, PA.

M-SCOPE Pipe Finder

LIGHTWEIGHT MODEL

Catalog No. 25M On Request

JOSEPH G. POLLARD CO., INC.

Pipe Line Equipment

New Hyde Park **New York**

damp places which are unsuitable for drip-proof or open motors.

To obtain further information on this new unit, use a Reader Service Card on which is entered the above key number and your name and address.

313

Hall Laboratories Use Spectrograph For Water Analysis

Hall Laboratories, Inc., Pittsburgh, Pa., are now using the spec-

trograph in the solution of water problems. The application of this scientific tool to identification of water-conditioning materials, compounds, boiler scale, deposits and sludges, and to other water-connected industrial research is still relatively new.

Electro Chemical Supply & Engr. Co. Moves

Appoints F. G. Baker Dir. of Engr.

The Electro Chemical Supply & Engineering Co. has announced the removal of its offices from Paoli, Penna. to its new office and plant at 750 Broad St., Emmaus, Penna.

The company has also announced the appointment of Fred G. Baker as Director of Engineering and Design. Mr. Baker was formerly with Du Pont.

314

Portable Compressor

The P. K. Lindsay Co., Everett, Mass., has announced a new heavier duty air compressor. Called Model 33, this unit has a displacement of 50 cfm. and delivers 33 cfm. at maximum recommended speed. Working pressure is adjustable to 100 lb. Multiple air chambers give adequate cooling and eliminate pulsations and automatic unloading ensures economy. The unit is operated by an 11 hp. two cylinder gasoline engine. Electrical starter and generator are available as optional factory installations.

In addition to the standard portable

Bury it and Forget it!

EDDY DOUBLE GATE VALVE

Since 1866 EDDY For Long Service

If you will think before buying a valve—you can eliminate thinking of it forever after. When you think of valves—think of the years of time and effort we have put into giving you a smooth-operating, trouble-free valve. Think of the progressive water works men who have relied on Eddy Valves for years—then specify and insist on getting Eddy Valves—you can bury them and forget them.

EDDY VALVE COMPANY
WATERFORD NEW YORK

A subsidiary of James B. Clow & Sons

mounting which weighs 450 lb., Model 33 is offered as a skid mounted unit.

To obtain further information on this portable compressor, use a Reader Service Card on which is entered the above key number and your name and address.

Macbeth Corp. Moves to New Plant

The Macbeth Corp., manufacturers of pH equipment, etc., has moved its entire offices from New York City to its new plant at Newburgh, N.Y. Newburgh is about 60 miles north of New York on the west bank of the Hudson River. The company will have not only its manufacturing plant but also its executive offices at the Newburgh site.

315

New C. I. Soil Pipe

Combustion Engineering - Superheater, Inc., has announced the introduction of an engineered cast-iron soil pipe made by a completely new and revolutionary process. Known as "Superspun," the new pipe is of uniform diameter and thickness throughout and has no seam. Its production process differs from other soil pipe in that precision control is gained by using sand-lined molds and concentric methods of forming the pipe. Centrifugal spinning molds assure uniform thickness throughout. "Superspun" can be cut with a pipe cutter much in the same manner as steel pipe.

To obtain further information on this new type of soil pipe, use a Reader Service Card on which is entered the above key number and your name and address.

LITERATURE AND CATALOGS

316

AERATORS

General Filter Co. of Ames, Iowa (a Layne affiliate), has a new and interesting 12-page bulletin entitled **"Aeration."** Profusely illustrated, this bulletin describes the variety of aerators and aeration units offered by General Filter Co. Amongst these are "The Cascade," the Coke Tray Aerator, and the unique GFC "Atomerator" which injects diffused air against operating pressures and thus constitutes an economical aerating unit with distinctive advantages over ordinary pressure air injections. All of these GFC units are especially interesting in connection with the aeration of small supplies where double pumping may prove an overly expensive procedure. These units are adaptable to installation in open ground tanks, elevated tanks or chambers under pressure. They are used for iron removal, odor and taste removal or degassification of waters containing carbon dioxide, hydrogen sulphide, etc. The bulletin describes benefits from aeration and/or degassification and pictures typical installations of each type of GFC Aerator and De-gasifier. Also, gives specifications covering each type.

For a copy of G.F.C. Bulletin 948 just fill out one of the handy Reader Service Cards, entering your name and address and insert the key number at the head of this item.

317

MEASURING AND CONTROL EQUIPMENT

Simplex Valve and Meter Co., Philadelphia, Penna., has available a general catalog on **Measuring and Control Equipment** for Water and

PIPE CLEANING TOOLS
FOR WATER LINES
FOR SEWER LINES

Above. "Flexible" Power Driven Pipe Cleaning Machine. Fast. Powerful. Safe.

Efficient Chain Head Cleaning Auger. A Power Driven Tool.

"Flexible" Carry-All Trailer, packs everything needed — Rod Reel, Steel Rods, Power Drive, etc.

Application of Power Cleaning Machine and Chain Head Auger in 4" Line.

a few minutes
k for Dodge
y to get at the
Root of the trouble
with "Flexibles."

"FLEXIBLE"

UNDERGROUND PIPE CLEANING CO.
SEWER-ROD EQUIPMENT CO.
9059 VENICE BOULEVARD, LOS ANGELES 34, CALIFORNIA

141 W. Jackson Blvd. Chicago, Ill.
401 Broadway New York 13
147 Hillside Ter. Irving, N. J.
P. O. Box 168 Atlanta
P. O. Box 463 Memphis, Tenn.
801 E. Excelsoir Blvd. Hopkins, Minn.
29 Cordon Ave. Roslindale 31, Mass.
Box 167 Los Nietos, Calif.
41 Greenway St. Hamden, Conn.
2786 Durango Ave. Los Angeles 34, Calif.
709 House Bldg. Pittsburgh 8, Pa.
4455 S. E. 24th Ave. Portland 2, Ore.
P. O. Box 447 Lancaster, Texas

Sewage Works, Power and Processing Industries.

The bulletin contains information on Controllers, Gauges, Flumes, Manometers, Meters, Pilot Equipment, Turbine Taps, Valves, and Venturi Tubes. The bulletin contains descriptions, drawings, pictures, diagrams, and cutaway drawings of the various pieces of equipment. This is more than an ordinary catalog, it is a reference work as well.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

318

BLADELESS SEWAGE PUMP

Fairbanks-Morse Co., Chicago, Ill., has issued a bulletin on its **Bladeless Sewage and Trash Pump.** The bulletin describes this unique pump, which will handle anything, gives details of its construction, and discusses both vertical and horizontal pumps and drive modifications. Principal dimensions are also given along with selection tables, typical specifications, and performance data.

To obtain a copy of this bulletin on the unique bladeless sewage and trash pump, use a Reader Service Card on which is entered your name and address and the above key number.

319

BAR SCREEN

Link-Belt Co., Philadelphia, Penna., has issued a bulletin on its new **Thru-Clean Bar Screen.** The bulletin describes this new unit which was designed for efficient removal of trash and large solids from water and sewage. A diagram and photographs show how the rakes clean thru the bar screen from the back.

The bulletin also describes the distinctive features which assure high efficiency and low overall cost. Specifications for the Link Belt Thru-Clean Bar Screen are also given.

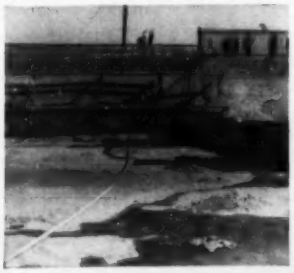
To obtain a copy of this new bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

320

DUAL FUEL ENGINES

Worthington Pump & Machinery Corp., Harrison, N.J., has issued a new bulletin on the **Worthington Dual Fuel Diesel.** This bulletin describes the modern design gas diesel which incorporates the advantages of the Worthington Dual Plunger Pump and the Worthington Automatic Thermal Air Control. The

"GUNITE" ENLARGES AND IMPROVES RESERVOIR



In 1947 we "GUNITED" the West End Reservoir at Hagerstown, Maryland. The pictures clearly show important stages in our work to give it greater capacity and to stop excessive leakage. After existing cracks in the concrete floor were sealed, "GUNITE" was applied to waterproof and reinforce the stone masonry and to add 30 inches to the height of the walls.

Many instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin C2400. A request on your letterhead will bring your free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA. U.S.A.
MANUFACTURERS OF THE CEMENT GUN

DETROIT'S Sparkling NEW HOTEL DETROITER

The most gracious hotel at the gateway to northern Michigan and Canada—in the heart of America's great automotive center 750 new outside rooms; every room with bath. Ample hotel parking space. Air-conditioned lounge, coffee shop and dining room . . . and ballroom

Convention and Group Meetings Invited

Woodward at Adelaide.

DETROIT

CONTROL *Gas Pressures*

From Digestion Tanks with NORWALK REGULATORS and CHECK VALVES

Handling sewage gas from digestion tanks is one of Norwalk Valve's activities in the manufacture of gas pressure control equipment. Stock items include check valves, pressure relief valves, regulators, all sizes and pressures. Illustrated are the Norwalk Disc Check Valve and the "Meter Cop" (a Norwalk exclusive).

DESIGN AND FABRICATION OF SPECIAL UNITS

Any unusual problems can be solved by our design and fabrication of special units. Norwalk products are made with ASTM and other materials required by contract specifications.

Outline your requirements in a note to us. We'll be glad to suggest designs and special equipment. We'll also send along a catalogue of our complete line of gas control equipment.

NORWALK VALVE COMPANY

33 RAILROAD AVENUE
SOUTH NORWALK, CONN.

Bulletin describes how for the first time the Automatic Thermal Control is adapted to the Dual Fuel Diesels, providing the correct air fuel ratio at all times and in direct relation to all load changes.

To obtain a copy of this interesting bulletin on the Dual Fuel Diesel, use a Reader Service Card on which is entered the above key number and your name and address.

321
KENNISON NOZZLE

Builders-Providence, Inc., Providence, R.I., has a 4-page folder on the **Kennison Nozzle for Open Flow.** This bulletin describes the Kennison nozzle, shows its installation, equipment with which it is connected for recording operations; its calibration, applications and description.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

322
CHEMICALS IN WATER & SEWAGE TREATMENT

Omega Machine Co., Providence, R.I., has reprinted the table on **Chemicals Used in Water & Sewage Treatment** by Henry F. Munroe. This table was originally prepared for *Water & Sewage Works* in which it was published in May 1949. The table contains complete information on 37 different chemicals, tells what type of containers they are shipped in, available forms, solubility, commercial strength and characteristics. It is the type of data table that every laboratory in a water or sewage plant should have.

To obtain a copy of this reprint, use a Reader Service Card on which is entered the above key number and your name and address.

323
CLOGLESS PUMPS

DeLaval Steam Turbine Co., has available a bulletin on the **DeLaval Clogless and Mixed Flow Pumps.** The 16-page bulletin shows these pumps and their design, with cutaway drawings, descriptions, and pictures of installations. Tables of dimensions are also given. Information is presented on both the Clogless design, which may be obtained for either horizontal or vertical installation, with direct or gear drive, and the mixed flow pump.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

324
TURBINE PUMPS

Johnston Pump Co., Los Angeles, Calif., has issued two interesting bulletins on **Johnston Turbine Pumps.** One shows the Johnston Oil Lubricated Pumps and the other the Water Lubricated Pumps. The texts of the two bulletins deals with the many applications for which these turbine pumps are designed, explain the interchangeability of parts, and by means of sectional drawings shows the components of the pumps and the modus operandi of the complete mechanism.

If you are faced with a water transfer problem you will find these booklets of interest. To obtain copies, use a Reader Service Card on which is entered the above key number and your name and address.

325
PRELOAD TANKS

Preload Enterprises, Inc., New York City, has issued a bulletin on **Preload Tanks.** The bulletin describes the evolution of the prestressed concrete tanks, shows the uses to which these tanks have been put, the method of construction, and the design and capacity chart. One

THE SILENT WATCHMAN

DIXIE TANK AND BRIDGE CO.

3523 LAMAR AVE. P. O. BOX 14
MEMPHIS 1, TENNESSEE

Complete Service for Elevated Water Tanks—Nation Wide Service—30 Years Experience

KEEP THE SAFETY FACTOR IN YOUR TANK THE DIXIE WAY

By welding seams, pits and rivets which gives a riveted tank 15% more Safety Factor than it had when built. No rivets removed, water supply maintained while work is in progress. On completely reconditioned jobs, the painting is guaranteed for five years, repairs guaranteed for ten years, provided the tank is painted every five years. Yearly inspection, making all adjustments, if any, without additional cost.

Write Us for Free Copy of Publication

SOUND PRINCIPLES OF WATER TANK MAINTENANCE and TANK TALK, by W. A. RILEY

—SAFETY—SERVICE—SATISFACTION—

COPYRIGHT 1949

THE LARGEST ORGANIZATION OF ITS KIND GIVING SAFE MAINTENANCE AT LOW COST

RELEASE EXCESS AIR

PREVENT AIR LOCKS

PROTECT PIPE LINES

WITH

APCO AIR RELEASE VALVES

ONE OF OUR

17 TYPES

NO. 200 AIR RELEASE VALVE
AIR AND VACUUM VALVES
PUMP PRIMERS
TANK AND VACUUM TYPES

VALVE & PRIMER CORPORATION

127 N. DEARBORN ST.
CHICAGO 2, ILL.

section of the bulletin is devoted to specifications, and another to questions and answers. Two pages are devoted to clientele. This bulletin is of interest to water and sewage works superintendents, managers, operators, and designing engineers.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

326

SULFUR DIOXIDE USES

Virginia Smelting Co., West Norfolk, Va., has available a bulletin on **Testing Methods — Recommended Practices — Specifications** of the Technical Service Department. Included in the bulletin are two articles on cleaning filter beds with liquid sulfur dioxide, plus diagrams on handling of cylinders, and graphs and text material on chemical properties, physiological effects, and suggestions for safe handling of sulfur dioxide.

To obtain a copy of this technical bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

327

MUNICIPAL SUPPLIES

W. S. Darley & Co., Chicago, Ill., has issued a complete catalog showing all of the **Municipal Supplies** which it handles. Containing more than 250 items of interest to municipalities, this catalog is of particular interest to superintendents and operators of water and sewage plants because it contains approximately 100 items that are used in either water works, sewage treatment plants or both. This is a handy catalog to have on file.

To obtain a copy, use a Reader Service Card on which is entered the above key number and your name and address.

328

SPIRAFLO CLARIFIERS

Lakeside Engineering Corp., Chicago, Ill., has issued a new bulletin

LEADITE

The Pioneer Self Caulking Material for C.I. Pipe

4 REASONS

why more miles of cast iron water mains are jointed with LEADITE than with any other melted self-caulking material:

- MELTS EASILY
- GOES FARTHER
- SAVES TIME, LABOR, COST OF MATERIAL
- MAKES A GOOD TIGHT JOINT THAT IMPROVES WITH AGE!

THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia 2, Pa.

No Caulking

TEST WATER HARDNESS

this SIMPLE, FAST, ACCURATE way

• • •

TAYLOR TOTAL HARDNESS SET

This new Taylor Set replaces the slow, inconvenient soap test . . . makes fast, accurate determinations on waters ranging in hardness from 1 to 1400 p.p.m. . . . ideal for checking boiler water or as a control test on zeolite or lime-soda treated waters.

HERE'S HOW SIMPLE A WATER HARDNESS TEST CAN BE . . .

You simply place a 50 cc. sample of the water to be tested in a 250 cc. flask with 2 drops of Taylor Hardness Indicator and 1 cc. of Taylor Hardness Buffer. At this point the sample will be red. Add Taylor Hardness Reagent from a burette until the red color changes sharply to blue. Multiply the burette reading in cc. by 20 and . . .

There's the Value!

WRITE FOR COMPLETE INFORMATION

Each Taylor Total Hardness Tester is sold complete . . . includes all necessary equipment and reagents. Write direct for prices and additional information. Also ask for the Taylor Handbook, "Modern pH and Chlorine Control".

W. A. TAYLOR AND CO.
7308 YORK RD • BALTIMORE 4, MD.

CAST IRON
Bell and Spigot Pipe

6" Class B — 1,035 feet
8" Class 150— 3,792 feet
8" Class 250— 4,328 feet
10" Class B —14,730 feet
12" Class B — 602 feet

Excellent Used Condition

Immediate Delivery below mill price

Write—Wire—Phone

SONKEN-GALAMBA CORPORATION
2nd and Riverview (X-245)
Kansas City 18, Kansas
THatcher 9243

Detectron 505
PIPE DETECTORS

FIRST WITH A METAL CASE
FIRST WITH SHIELDED LOOPS
FIRST WITH "SURE GRIP" HANDLE
FIRST WITH LIFETIME GUARANTEE

The new DETECTRON Model 505 locates, traces and centers pipes and cables with speed and accuracy. Small, compact, lightweight—with HEAVY DUTY PERFORMANCE.

- HIGHER QUALITY
- LONGER LIFE
- LOWER PRICE

TRIPLE VALUE!

For Complete Information Write for Folder 3-N

THE Detectron CO.
5637 CAHUENGA BLVD NORTH HOLLYWOOD, CALIF.

on **Spiraflo Clarifiers.** These units, which employ peripheral feed and center collection in combination with upward flow are completely described in this bulletin. In addition to photographs of actual typical installations, the bulletin also gives design data and shows details of scum pipe assembly, and dimensions of clarifiers. Also presented are different layouts which utilize the Spiraflo Clarifiers for both primary and secondary purposes. The bulletin concludes with specifications and a description of the Trebler Sampler.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

329
VACUUM FILTRATION

Filtration Engineers, Inc., Newark, N.J., has released a new 24-page two color bulletin outlining the principles of continuous **Rotary Vacuum Filters.** A cut-away drawing shows how the rotary vacuum filter operates and discusses the Feinc String Discharge, the compression mechanism which removes from 2 to 6 percent more moisture, the Feinc washing mechanism, automatic valve, drainage members, and high and low submergence types. Installation diagrams are shown and construction features are presented. One page is devoted to the pilot plant filter which the company has available, and several pages show typical applications.

To obtain a copy of this bulletin on vacuum filters, use Reader Service Card on which is entered the above key number and your name and address.

330
WEDGE-SLOT SCREEN

Hendrick Mfg. Co., Carbondale, Pa., has published a 4-page bulletin on the **Hendrick Wedge-Slot Screen.** This bulletin shows the type of screen made for use in processing equipment, shakers, vibrators, sewage disc screens, revolving screens, dewatering equipment, industrial waste treatment, and other uses.

To obtain this information on the wedge-slot screen, use a Reader Service Card on which is entered the above key number and your name and address.

331
BETHLEHEM FLOW TUBE

Energy Control Co., Inc., New York, N.Y., has available a six page bulletin on the **Bethlehem Flow Tube.** This is the flow tube developed from the Gentile patent. It is presented as having greater simplicity of construction and installation, because of the fact that it is usually less than one pipe diamter in length. The bulletin shows the principle of operation, and also diagrams of test results.

To obtain a copy of this bulletin on the Flow Tube, use a Reader Service Card on which is entered the above key number and your name and address.

332
MERCURY SWITCHES

Minneapolis Honeywell Regulator Co. makes, among other things, **Mercury Switches.** Few people realize the number of installations of mercury switches in water and sewage works. This bulletin does not cover those fields, but does show the actual construction and operation of these switches.

If you are interested in mercury switches, use a Reader Service Card on which is entered the above key number and your name and address.

333
CHLORINE DISPENSER

Fischer & Porter Co., Hatboro, Penna., has published a bulletin on its **Rato-Chlor Chlorine Dispensers.**

Taste and Odor Control

WITH OTHER ADVANTAGES ALL IN ONE PACKAGE

BLACKALUM offers

★ The high alumina content and the advantages of insolubles found in Activated Alum, plus—

★ The well-known taste and odor control properties of Activated Carbon.

★ Use it year round and keep your sludge stabilized.

★ Shipment as you want it, when you want it.

Activated Alum Sales Corporation
516 North Charles Street
Baltimore 1, Maryland

A CLEAN CUT
IN 3 MINUTES
Through 18" A-C with
SPRING LOAD A-C!
PAYS ITS COST ON ONE JOB!
Because it cuts many times faster than any other method, and requires but *one tenth* the maintenance, SPRING LOAD A-C means real economy. No preliminary multiple parts assembly necessary . . . takes but a few seconds to set up . . . one man can handle, basic tool cuts 3" to 8" I.D. pipe. Extension available for handling larger pipe. Ask your jobber or write.
H. D. FOWLER CO., Inc.
P.O. Box 3064
Seattle 14, Wash.

This eight-page illustrated catalog describes and illustrates the self-contained cabinet type units with capacities ranging from 1 to 1200 lb. per day. Also shown are the design features, and a layout for a high capacity chlorine dispensing system.

To obtain a copy of this new bulletin describing the improved chlorine dispenser, use a Reader Service Card, on which is entered the above key number and your name and address.

334

TOOLS

Trimont Manufacturing Co., Roxbury, Mass., has issued an 8-page catalog on **Trimo Tools**. Featured in the bulletin are pipe wrenches, including the heavy duty Trimo Alloy and Roxco and the normal duty popular Stillson; monkey wrenches, pipe cutters and wheels; strap wrenches, pipe vises; and sawing vise sets.

To obtain a copy of this catalog, use a Reader Service Card on which is entered the above key number and your name and address.

335

TRI-CLAD MOTOR

General Electric Co., Schenectady, N.Y., has published a bulletin on The **New Tri-Clad Single-Phase Capacitor Motor.** This bulletin describes the new features of this motor, its compact size, longer life bearings, new terminal board, extra protection against physical damage, electrical breakdown, and operating wear and tear, and the bulletin also tells how easy it is to install, the construction features, specifications and characteristics.

To obtain a copy of this bulletin, use a Reader Service Card on which is entered the above key number and your name and address.

336

OPERATING COST GUIDE FOR CRANES, SHOVELS AND DRAGLINES

The Power Crane and Shovel Assn., New York City, N.Y., has issued an **Operating Cost Guide** for estimating the cost of ownership and operation of power shovels, hoes, draglines, clamshells and cranes of sizes up to 2½ cu. yd. and 50 tons.

The 24-page bulletin contains three sections: Fixed Costs, Operation Costs, Other Costs.

The bulletin may be obtained at a cost of 50 cents per copy from the Power Crane and Shovel Assn., 74 Trinity Place, New York 6, N.Y.

36 WORDS ABOUT SEWAGE TREATMENT 36

The Bio-Chemical Process (a Guggenheim development) is a proved, economical, complete treatment of sewage—lowest first cost—lowest operating costs, utilizing community trade wastes to treat sewage.

Investigate this process without cost or obligation.

(If you counted only 34 words, you probably didn't realize that "economical" and "proved" are doubly important in connection with the Bio-Chemical Process)

THE BIO-CHEMICAL PROCESS

OFFICES AND LABORATORIES:
2266 N. Meridian, Indianapolis 8, Ind. • 120 Broadway, New York 5, N. Y.

A DEPENDABLE JOINTING COMPOUND

FOR BELL AND SPIGOT WATER MAINS

HYDRO-TITE

HYDRAULIC DEVELOPMENT CORP.
MAIN SALES OFFICE • General offices and works
50 CHURCH ST. N.Y.C. • W. Medford Sta. Boston, Mass.

MOTOR TRUCK MOUNTING
FOR GATES TO 60 IN.
★ ★ ★ ★
PORTABLE FOUR WHEEL TYPE
GATES UP TO 48 IN.
★ ★ ★
FOR SMALL GATES IT'S THE POWERENCH
GAS ENGINE DRIVE
PORTABLE, WEIGHS 37 LBS.

DEAN GATE OPERATORS

PAYNE DEAN & CO. MADISON, CONN.

STOP
JOINT LEAKAGE
USE
CARSON CLAMPS
With Pearlitic C.I. Bolts for Cast Iron Pipe and Fittings.
Write for Prices.
Carson-Cadillac Co.
1221 PINSON ST. BIRMINGHAM, ALA.

Since 1886
"Ebony Paint Kills Rust"
A Refined Coal Tar Base Paint
Rust has never been found under EBONY PAINT in its more than sixty years' history.
Specified by many Engineers for Sewage Disposal and Water Plants.
Quart sample and literature on request.
Ebony Paint Manufacturing Co.
18th & Agnes Ave.
KANSAS CITY 1, MISSOURI

Consulting Engineers

SPECIALIZING IN THE FIELD OF

WATER & SEWAGE WORKS

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Water, Sewage and Industrial Waste Problems — Airfields, Refuse Incinerators, Power Plants — Industrial Buildings
City Planning—Reports—Valuations
Laboratory
121 South Broad Street, Philadelphia 2, Pa.

BLACK & VEATCH
Consulting Engineers
Water — Sewage — Electricity
Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
4706 Broadway, Kansas City 2, Missouri

CAPITOL ENGINEERING CORPORATION
Engineers—Constructors—Management
SEWAGE SYSTEMS — WATER WORKS
Designs and Surveys — Roads and Streets
Planning — Airports
Bridges — Dams
Executive Offices
DILLSBURG, PENNSYLVANIA

Alvord, Burdick & Howson
Engineers
Charles B. Burdick
Louis R. Howson
Donald H. Maxwell
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation
Civic Opera Building — Chicago

Clinton L. Bogert Associates
CONSULTING ENGINEERS
Clinton L. Bogert — Ivan L. Bogert
J. M. W. Greg — Robert A. Lincoln
Donald M. Ditmars — Arthur P. Ackerman
Water & Sewage Works
Refuse Disposal — Industrial Wastes
Drainage — Flood Control
624 Madison Avenue, New York 22, N.Y.

The Chester Engineers
Water Supply and Purification, Sewerage and Sewage Treatment, Power Development and Applications, Investigations and Reports, Valuations and Rates.
210 E. Park Way at Sandusky, Pittsburgh 12, Pa.

ARGRAVES & MORT
ENGINEERS
Sewerage and Sewage Treatment
Refuse Disposal—Industrial Wastes
Water Supply and Purification—Dams
70 COLLEGE ST. — NEW HAVEN, CONN.

Bowe, Albertson & Associates
ENGINEERS
Sewerage—Sewage Treatment
Water Supply—Purification
Refuse Disposal—Analyses
Valuations—Reports—Designs
110 William St. — 2082 Kings Highway
New York 7, N. Y. — Fairfield, Conn.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply—Sewerage—Flood Control & Drainage — Bridges — Express Highways — Paving—Power Plants—Appraisals—Reports —Traffic Studies—Airports
351 East Ohio Street
Chicago 11, Ill.

JOHN J. BAFFA
Consulting Engineer
Water Supply and Treatment
Sewerage and Sewage Treatment
75 West Street — New York 6, N. Y.

Buck, Seifert and Jost
Consulting Engineers
(Formerly Nicholas S. Hill Associates)
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories
112 East 19th St. — New York

DE LEUW, CATHER & COMPANY
Water Supply — Sewerage
Railroads — Highways
Grade Separations—Bridges—Subways
Local Transportation
Investigations — Reports — Appraisals
Plans and Supervision of Construction
150 North Wacker Drive — Chicago
79 McAllister Street — San Francisco 2, Calif.

Michael Baker, Jr.
The Baker Engineers
CIVIL ENGINEERS AND PLANNERS
MUNICIPAL ENGINEERS
Airport Design—Sewage Disposal Systems
Water Works Design and Operation
Consulting Services — Surveys and Maps
HOME OFFICE—ROCHESTER, PA.

BURGESS & NIPLE
Civil and Sanitary Engineers
Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations
584 East Broad Street
Columbus 15, Ohio

Fay, Spofford & Thorndike
Engineers
Charles M. Spofford — Ralph W. Horne
John Ayer — William L. Hyland
Elon A. Bowman — Frank L. Lincoln
Carroll A. Farwell — Howard J. Williams
Water Supply and Distribution — Drainage
Sewerage and Sewage Treatment — Airports
Investigations and Reports
Designs — Valuations
Supervision of Construction
Boston — New York

W. H. & L. D. BETZ
CONSULTING ENGINEERS
INDUSTRIAL WASTE
INDUSTRIAL WATER
ANALYSIS — DESIGN
INVESTIGATIONS — OPERATION
Gillingham & Worth Sts.
Philadelphia 24, Pa.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo.
P.O. Box 7088
Cleveland, Ohio
1400 E. 9th St.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
ENGINEERS
Pittsburgh, Pa. — Scranton, Pa.
HARRISBURG, PA.
Water Works, Sewage, Industrial Wastes & Garbage Disposal—Roads, Airports, Bridges & Flood Control. Town Planning, Appraisals, Investigations & Reports.

BLACK LABORATORIES, INC.
Consulting Engineers and Chemists
On all Problems of
Water, Sewage, and Waste Treatment
ANALYSIS · TREATMENT CONTROL
RESEARCH
905 South Oak Street
Gainesville, Florida

Camp, Dresser & McKee
Consulting Engineers
6 Beacon Street, Boston 8, Mass.
Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York — Reading, Pa. — Washington
Houston — Philadelphia

(See next page also)

Ivan M. Glace

Consulting Sanitary Engineer

WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT

Design, Construction and
Supervision of Operation

Telephone 6-5407 — 1801 North Front St. Harrisburg, Pa.

ENGINEERING OFFICE OF CLYDE C. KENNEDY

COMPLETE ENGINEERING SERVICE
For More Than a Quarter Century
Investigations, Reports, Design, Supervision of Construction and Operation
Water Supply, Water Conditioning, Sewerage, Sewage and Industrial Waste Treatment
CHEMICAL and BIOLOGICAL LABORATORY
804 Mission Street — San Francisco, 5

The Pitometer Company

Engineers

Water Waste Surveys, Trunk Main Surveys, Water Distribution Studies
Penstock Gaugings

New York, 49 Church St.

WILLIAM A. GOFF, INC.

General Engineering and Consulting Services—Water, Sewerage, Refuse Incineration, Industrial Buildings, Power Plants, Airport, Town Planning Plans, Supervision, Valuations, Reports

Broad St. Station Bldg., Philadelphia 3, Pa.

Morris Knowles, Inc.

Engineers

Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning

1312 Park Building, Pittsburgh, Pa.

LEE T. PURCELL

Consulting Engineer

Water Supply and Purification
Sewerage and Sewage Disposal
Industrial Wastes
Design, Supervision of Construction and Operation
Complete Laboratory Services

1 LEE PLACE
PATERSON 1, NEW JERSEY

GREELEY AND HANSEN

Engineers

Samuel A. Greeley — Paul Hansen (1920-1944)
Paul E. Langdon — Kenneth V. Hill
Thomas M. Niles — Samuel M. Clarke

Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal

220 S. State Street, Chicago 4

WM. S. LOZIER CO.

Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal

Consulting Engineers

10 Gibbs Street — Rochester 4, N. Y.

Thomas M. Riddick

Consulting Engineer and Chemist

Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.

369 East 149th Street
New York 55, N. Y.

Havens & Emerson

W. L. Havens — C. A. Emerson
A. A. Burger — F. C. Tolles — F. W. Jones

Consulting Engineers

Water, Sewage, Garbage, Industrial Wastes, Valuations—Laboratories

Leader Building, Cleveland 14 — Woolworth Bldg., New York 7

Metcalf & Eddy

Engineers

Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airfields — Valuations
Laboratory

Statler Building, Boston 16 — 111 Sutter St., San Francisco 4

ROBERT AND COMPANY ASSOCIATES

Architects & Engineers

• ATLANTA •

WATER SUPPLY • INCINERATORS
SEWAGE DISPOSAL • POWER PLANTS

Hayden, Harding & Buchanan

Consulting Engineers

John L. Hayden
John H. Harding — Oscar J. Campia

Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural

828 Park Square Building, Boston, Mass

INDUSTRIAL WASTE CONSULTANTS

(A Guggenheim Subsidiary)

INVESTIGATIONS AND REPORTS

Offices and Laboratories
2266 No. Meridian, Indianapolis 8, Indiana
120 Broadway, New York 5, New York

Russell B. Moore—A. F. Nelson—Robert J. Theroux
(Memberships in ASCE, AWWA, AIMME, CSSWA, ACS)

Russell & Axon

Consulting Engineers

Geo. S. Russell — F. E. Wenger
Joe Williamson, Jr.

Water Works, Sewerage, Sewage Disposal, Power Plants, Appraisals

409 Olive Street, St. Louis 2, Mo. — Municipal Airport, Daytona Beach, Fla.

Charles Haydock

Consulting Engineer

Water Works and Sanitation, Industrial Wastes, Design, Construction, Operation and Management. Reports and Valuations.

2314 Girard Trust Company Building
Broad Street and South Penn Square
Philadelphia 2, Pa.

Nussbaumer, Clarke & Velzy, Inc.

Newell L. Nussbaumer — Irving Clarke

Water Supply and Treatment
Sewerage & Sewage Disposal
Garbage Incineration
Town Planning

52 Vanderbilt Ave., N. Y. City

327 Franklin St., Buffalo, N. Y.

J. E. SIRRINE Company

Engineers

Water Supply & Purification
Sewage & Industrial Waste Disposal
Stream Pollution Reports
Utilities, Analyses

Greenville — South Carolina

HITCHCOCK & ESTABROOK, Inc., LESTER D. LEE, Associate

Professional Engineers and Architects

Consultants to Municipalities since 1920

WATER, SEWERAGE, PAVING, POWER PLANTS, AIRPORTS, REPORTS AND APPRAISALS

121 Sexton Bldg.
Minneapolis 15, Minnesota

PARSONS, BRINCKERHOFF, HALL & MACDONALD

G. Gale Dixon, Associate
ENGINEERS

Dams, Water Works, Sewerage, Airports, Bridges, Tunnels, Traffic & Transportation Reports, Highways, Subways, Foundations, Harbor Works, Valuations, Power Developments, Industrial Buildings

51 Broadway, New York 6, N. Y.

Benjamin L. Smith & Associates

Engineers

Investigations — Reports
Designs — Supervision — Valuations
Municipal Engineering and Public Utilities

11 North Pearl Street
Albany 7, New York

Jones, Henry & Schoenmaker

(Formerly Jones & Henry)

Consulting Sanitary Engineers

Water Works
Sewerage & Treatment
Waste Disposal

Security Bldg. — Toledo 4, Ohio

Malcolm Pirnie Engineers

Civil & Sanitary Engineers

Malcolm Pirnie — Ernest W. Whitlock
Richard Hazen — G. G. Werner, Jr.

Investigations, Reports, Plans
Supervision of Construction and Operations
Appraisals and Rates

25 West 43rd St., New York 18, N. Y.

STANLEY ENGINEERING COMPANY

Consulting Engineers

Water Works—Sewerage
Electric Power—Flood Control
Rate Studies—Valuations—Industrial
Airports . . . . . Municipal Buildings

Hershey Bldg., Muscatine, Ia.

(Continued on next page)

CONSULTING ENGINEERS

Specializing in the Field of

WATER AND SEWAGE WORKS

Philip B. Strasnder & Affiliates
Consulting Engineers
120 Tremont St., Boston 8, Mass.
Water Supply, Treatment, Distribution
Trade Wastes, Refuse Disposal
Sewerage, Sewage Treatment
Plans, Supervision, Reports

Weston & Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service
Supervision, Valuations
14 Beacon St. Boston, Mass.

Whitman & Howard
Engineers (Est. 1869)
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

WHITMAN, REQUARDT AND ASSOCIATES
Engineers — Consultants
Civil—Sanitary—Structural—Mechanical—Electrical. Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine
WATER & SEWAGE WORKS

STOP WATER SEEPAGE SEWAGE CORROSION
WITH FORMULA No. 640
a clear liquid penetrating (1"+) sealer for concrete and masonry preventing water absorption and reducing the action of acids. Holds 12' hydrostatic head. Use our Hayproc Rubberised Enamel for color on walls and floors—not affected by concentrated acids, alcohol, oil, or traffic abrasion.
30 OTHER PRODUCTS
Write for technical data.
Haynes Products Co., Omaha 3, Nebr.
See our file in Sweet's

INDEX TO ADVERTISERS

A

Activated Alum Corp. 114A
Aluminum Company of America ... 7A-29A
American Concrete Pipe Ass'n 28A
Anthracite Equipment Co. 103A

B

Badger Meter Mfg. Co. 6A
Bio-Chemical Process, The 115A
Blaw-Knox Co. 93A
Bucyrus-Erie Hydrocrane Div. 25A
Buffalo Meter Co. 104A
Builders-Providence, Inc. 102A
Byers Co., A. M. 99A

C

Carson-Cadillac Corp. 115A
Carter Products Corp. 95A
Cast Iron Pipe Research Ass'n ... 10A-11A
Cement Gun Co. 111A
Centriline Corp. 108A
Chain Belt Company 27A
Chicago Bridge & Iron Co. 21A
Chicago Pump Company 91A
Crane Co. 22A

D

Darley & Co., W. S. 97A
Darling Valve & Mfg. Co. 20A
Detectron Co., The 113A
Diamond Alkali Company 19A
Directory of Engineers ... 116A-117A-118A
Dixie Tank & Bridge Co. 112A
Dorr Co. ..... Inside Back Cover
Dow Chemical Co. 96A
Dresser Mfg. Division 18A

E

Ebony Paint Mfg. Co. 115A
Eddy Valve Co. 109A

F

Filer & Stowell 100A
Flexible Sewer-Rod Equipment Co. ... 110A
Flexible Underground Pipe Cleaning Co. 110A
Ford Meter Box Co. 103A
Fowler Co., Inc., H. D. 114A

G

General Electric Company (Disposall) 8A-9A
General Electric Co. 38-39
Glauber Brass, Inc. 92A
Golden-Anderson Valve Specialty Co. . 16A

H

Haynes Products Co. 118A
Hellige, Inc. 107A
Hydrauger Corp. 93A
Hydraulic Development Corp. 115A

I

Industrial Chemical Sales Co. 33A
Infilco, Incorporated 30A
Iowa Valve Company 34A

J

Jeffrey Mfg. Co. 27A
Johns Manville 14A-15A

L

Layne & Bowler 31A
Leadite Company 113A
Leopold Co., F. B. 107A
Link-Belt Company 17A
Lock Joint Pipe Co. ..... Inside Front Cover

M

M. & H. Valve Fitting Co. 105A
Mathieson Chemical Corp. 4A

N

Neptune Meter Company 42A
Nordstrom Valve Div. (Rockwell) ... 35A
Norwalk Valve Co. 111A

O

Omega Machine Co. 12A

P

Pacific Flush Tank Company 32A
Payne Dean & Co. 115A
Phelps Dodge Refining Corp. 105A
Phipps & Bird Inc. 97A
Pilot Mfg. Co. 92A
Pittsburgh-Des Moines Steel 36A
Pollard Co., Inc., Joseph G. 109A
Proportioneers, Inc. 33A

R

Ridge Tool Co. 101A
Roberts Filter Mfg. Co. 109A
Rockwell Mfg. Co. 3A
Roots-Connersville Blower Corp. 94A

S

Smith Mfg. Co., A. P. 34A
Smith, S. Morgan 26A
Sonken-Galamba Corp. 112A
Sparling, R. W. 98A

T

Taylor & Co., W. A. 112A
Tennessee Corp. 106A

U

U.S. Pipe & Fdry. Co. 40A

V

Valve & Primer Co. 113A

W

Wallace & Tiernan Co., Inc. ... Back Cover
Warren Foundry & Pipe Corp. 98A
Williams Gauge Co. 107A
Wood Company, R. D. 13A

Z

Zeolite Chemical Co. 103A

IN GRIT CHAMBER DESIGN

it's the AREA that counts!

Why is area important?

Because without sufficient settling area, no grit chamber can remove enough of the plus 65 mesh sand and inorganics that cause trouble in most sewage plants. This has been proven conclusively by research and field tests.

What unit provides sufficient area?

The Dorr Detritor, designed on an *area* basis, will mechanically remove and wash 95% of plus 65 mesh material . . . under maximum flow conditions . . . regardless of feed composition. Coarser or finer separation are possible if required.

Dorr Detritors have these plus benefits!

No overloading or stalling . . . the grit collecting mechanism has hinged, torque-actuated arms, which automatically raise and work off peak loads of grit.

Long Life . . . maintenance is negligible . . . all bearing and wearing parts are above water . . . abrasive action from grit and sewage is completely eliminated.

Produces a drained and washed grit containing not more than 3% by weight of putrescible organics . . . eliminates any odors, unsightliness or septic action.

* * *

Dorr Detritors are available in two types and a variety of sizes to fit the largest or smallest plant requirements. If you have a grit removal problem, write for a complete technical reprint on design factors in grit removal and washing.

DORR

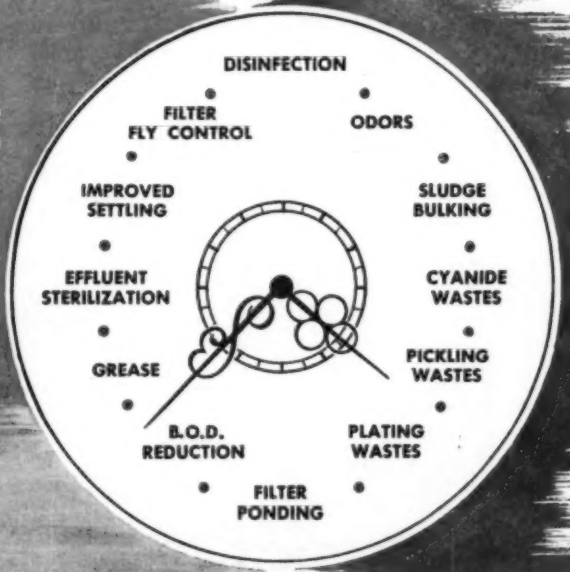
RESEARCH [illegible] ENGINEERING [illegible] EQUIPMENT

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.
NEW YORK • ATLANTA • TORONTO
CHICAGO • DENVER • LOS ANGELES
RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.

SUGAR PROCESSING
PETREE & DORR DIVISION, STAMFORD, CONN.
ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

It's always time for CHLORINATION



W&T SEWAGE CHLORINATOR

Chlorination time at a modern sewage treatment plant knows no hour or season — it's always the right time to use this versatile tool in the solution of the numerous problems the average operator faces every day. For example, chlorination *controls odors* at Fort Wayne, Indiana; reduces *filter ponding* at Rotterdam, New York; and *sterilizes the effluent* of the Easterly Sewage Plant at Cleveland, Ohio.

Best of all, the advantages of chlorination aren't expensive. The average installation represents less than 1% of total plant cost.

Why not make it "chlorination time" in your plant now. Call your nearest W&T Representative for the benefit of over 35 years' experience in chlorination, a full line of equipment for every sewage plant need, the practical knowledge gained in making thousands of installations, and the availability of a nationwide service staff.

S-50

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES